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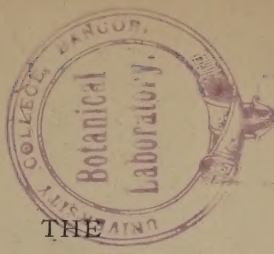

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THE

STUDENT'S HANDBOOK

OF

BRITISH HEPATICS

By SYMERS M. MACVICAR

AUTHOR OF "THE DISTRIBUTION OF HEPATICAE IN SCOTLAND," ETC.

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PREFACE

THE want of an illustrated book on our Hepaticae, at a moderate cost, has been felt for some time. Pearson's large work, "The Hepaticae of the British Isles," 1899-1902, which has done so much to stimulate interest in the subject, was necessarily published at a price beyond the reach of many students. With the exception of that book, no illustrated account of our species has appeared since Cooke's "Handbook of British Hepaticae" in 1894. The most recent work, Lett's "List of British Hepatics" (1902), is without illustrations. This country has participated in the greatly increased interest in Hepaticae which has taken place in recent years, both on the Continent and in America, and it is hoped that the present volume will add to the number of students of this subject, as well as be of interest to those more advanced. Whatever assistance the book may be to them will be largely increased by the excellent and accurate drawings which Mr. Jameson undertook to do for me. Exigences of space prevented the various parts of the plants being drawn on a uniform scale even if it had been desirable in this class of plants which vary so much in size, but the figures of the leaf-cells in the foliose species are all drawn to one scale.

Several correspondents have kindly assisted by sending specimens. Especially are thanks owing to Mr. D. A. Jones (Harlech) and Mr. W. E. Nicholson (Lewes), who have sent to Mr. Jameson many living plants for the drawings, and have sent to me various specimens, also affording ready assistance in other ways.

It is difficult to make sufficient acknowledgment of the assistance which I have received from Mr. Jameson. Not only has he read the manuscript during a large part of the progress of the work, making many valuable suggestions and criticisms, and assisted in revising the proof sheets, but he has taken on his shoulders all the trouble connected with passing them through the press, and making the Index.

INVERMOIDART,
ACHARACLE,
July, 1912.

INTRODUCTION

THE Hepaticae or Liverworts, which form the lower of the two classes into which it is still generally the custom to divide the Bryophyta, have a much greater variety in their vegetative organs than have the higher class, the Musci or Mosses. They differ from the Musci in having unicellular rhizoids, in having spiral threads (elaters) nearly always mixed with the spores, and, to some extent, in their embryogeny; but otherwise there are no characters which are confined to either class alone. There are however some general differences, which characterise them when taken as a whole, such as the Hepaticae having usually a rudimentary and short-lived protonema, the leaves frequently bilobed (which never occurs in the Musci) and generally bilateral, the areolation mostly hexagonal, the capsule remaining within the calyptra until the spores are mature and commonly dehiscing by four valves, the peristome being absent and the columella nearly always so, and the pedicel of the capsule being hyaline. For practical purposes, the bilateral leaves, which are frequently lobed and always without a distinct midrib, and the more delicate texture of the plant, will suffice for the recognition of the foliose Hepaticae, and, as there are no transitional forms between the two classes, the beginner will almost at once learn to distinguish them with certainty.

Both classes have a well-defined "alternation of generations." From the germinating spore arises the green "plant-body" or *gametophyte*, which bears the sexual organs, the antheridia and archegonia. This is the sexual generation. The fertilized egg within the archegonium gives origin to the *sporophyte*, or asexual generation, and from the spores which this produces the gametophyte or sexual generation again arises. The sporophyte, the chief function of which (as its name implies) is to produce spores, remains in contact with the gametophyte throughout its life, and has rarely, in the Hepaticae, any independent power of growth. It absorbs nourishment from the gametophyte, usually by means of a special absorbing organ, the *foot*, and lives on it as a parasite. The gametophyte is a green plant, capable of leading an independent life, and is generally much larger than the sporophyte. In the Hepaticae it constitutes the "plant" as popularly understood. The sexual organs are frequently absent, the plant progagating itself by other means. When present, they may be on the same or on different plants.

The student will find a detailed account of the morphology of the Hepaticae in works devoted to that branch of the subject. Only certain matters, which may help to elucidate the descriptions in this book, will be noticed here.

Vegetative Organs

The plant-body, or gametophyte, shows a large amount of variability. It ranges from being a flat ribbon-like thallus to possessing a cylindrical stem with distinct leaves, while between these there are forms which are intermediate in different degrees. It is nearly always more or less prostrate, with the two surfaces differing from each other, and is thus said to be "dorsi-ventral." On the ventral side there are unicellular rhizoids, which are absent only in a very few species. In size the gametophyte varies from being several centimetres long to being almost invisible to the naked eye.

The popular division of the Hepaticae into thallose (or frondose) and leafy forms, though not exact, assists the student in understanding their general appearance. Taken in this sense, the thallose species comprise those which consist of a thallus without any indication of leaves, as well as those in which the gametophyte, while appearing to be a thallus, is in fact only an expanded axis with lateral appendages, arising in the same regular manner as leaves, and which are in reality leaves.

The thallus varies greatly in its internal structure. It is sometimes composed of differentiated layers of tissue of various degrees of complexity, or it may consist of cells which are uniform throughout.

The gametophyte presents the following modifications in the different orders and families of the Hepaticae.

The *Marchantiales* are composed of species which have a complex internal structure of the thallus. There is a lower compact, colourless zone of parenchymatose cells without chlorophyll or nearly so, and an upper zone of chlorophyllose filamentose tissue. Between the filaments are narrow air-spaces, or in some species large air-chambers. The under surface is attached to the soil by unicellular "smooth" rhizoids, and on each side of the thickest part of the thallus there is a longitudinal row of scales. In addition to the smooth rhizoids there are other rhizoids which have peg-like papillae projecting into their inner surface: these "tuberculate" rhizoids arise in bundles, and lie in the axils of the ventral scales which protect them; they have free ends and serve for the conduction and storage of water. The degree of internal differentiation of the thallus varies from the lower to the higher forms.

The *Ricciaceae* have the least amount of elaboration of the thallus. In the typical species (*Euriccia*) the compact tissue is composed of some layers of colourless cells; above this, the chlorophyll-bearing layer is composed of closely set filaments consisting of a single row of cells, between which lie narrow air-spaces [*10. 2, 4, 5.]. The uppermost cells of each filament become enlarged to form a continuous layer, which is the dorsal epidermis. The ventral scales are originally in one row on the middle of the lower surface, but by the expansion of the growing thallus they become split into two rows, one on each side of the median line. They generally soon wither and may only be seen close to the apex, protecting the growing point, but in some xerophytic species they are permanent, and assist in preventing evaporation from the thallus. In the subgenus *Ricciella* the air-spaces become much enlarged, owing to the expansion of the older parts of the thallus. If the dorsal layer increases proportionally with the lower layers, it forms a continuous epidermis as in *R. fluitans* [14. 2.], but if it does not, the epidermis ruptures and leaves open cavities as in *R. crystallina* [12. 2.]. In *Ricciocarpus natans* the thallus consists almost wholly of air-chambers which are separated from each other by partitions which are one cell thick [15. 3.]. The uppermost chambers open on the dorsal surface by pores in this genus.

The *Marchantiaceae* have a more highly developed thallus, and shew various degrees of this development in the different genera. They nearly always have a single layer of definite air-chambers, the floor of these being sharply defined from the colourless subjacent tissue, and having filaments of assimilative tissue arising from it which have free ends [18. 3.]. The filaments which bound the chambers are usually attached above, to the dorsal epidermis, as well as below, forming a network which can usually be distinguished on its upper surface. The chambers open through the epidermis by means of pores, each pore occupying the centre of one of the meshes of the network referred to above, and being surrounded by concentric rings of guard-cells. The guard-cells either form a layer continuous with, and more or less in the same plane as the dorsal epidermis, with a single central opening, the pores in this case being "simple" [18. 2, 3]; or they form a cylinder composed of four or five rings of superimposed cells more or less at right angles to the epidermis, and with an opening above and below, these being named "compound" or "barrel-shaped" [21. 3, 4.] In *Reboulia*, air-chambers of the primary layer enlarge and become divided by thin walls, forming a network of chambers somewhat

* In these references to the figures in the text, the number in heavy type is that of the species illustrated, those in lighter type referring to the separate figures in the illustration.

resembling those of *Ricciocarpus natans*; in this case the green tissue is not so sharply defined from the compact colourless zone. The ventral scales originate usually in two rows in the *Marchantiaceae*, and not by the splitting of a single median row as in the *Ricciaceae*; they are generally persistent, and differ in shape in the various genera. The papillae of the tuberculate rhizoids are also longer than in the *Ricciaceae*. Oil-bodies and mucilage cells are found in the compact tissue of most species, and occasionally a mycorhizal zone. Rarely elongated fibrous cells are also present, as in *Preissia*.

The *Jungermanniales* contain both thallose and leafy forms. In the former the thallus is composed of nearly uniform cells, is without air-chambers or pores, and tuberculate rhizoids are absent. The *Anacrogynae* are mostly thallose and dorsi-ventral, but many of the genera show indications of leaves in different degrees, while a few genera have the leaves and stem-axis sharply separated. *Aneura*, *Metzgeria*, *Pellia* and *Moerckia* show no sign of any indication of leaves, while *Blasia* has the thallus divided into lateral lobes which originate in the same manner as leaves, and are in reality leaves, though the term "thallus-lobes" is generally applied to them. In *Petalophyllum* the leaves are arranged in vertical laminae on the expanded midrib, while in *Fossombronia* the leaves are generally, though not always, sharply separated from the midrib. *Haplomitrium* differs from the other genera in several ways, as it also does from all other Hepaticae. The plant is not dorsi-ventral, the stems being erect with spirally arranged leaves; the stems arise from a branched rhizome-like basal portion, and rhizoids are absent.

Of the entirely thallose genera, *Metzgeria* has a sharply separated midrib and one-layered wings; *Moerckia* has a broad midrib not so sharply defined. In this last genus the thallus is not always entirely composed of parenchyma, there being sometimes two lateral strands of elongated, lignified cells in the midrib. In *Pallavicinia* there is a central strand of more fully developed lignified cells [**34.** 2, 4.]. These cells act as conducting tissue for water.

The thallus of the *Sphaerocarpales* agrees with that of the *Anacrogynae* in being without air-chambers or tuberculate rhizoids. Our species of *Sphaerocarpus* have a simple thallus with a broad, indefinite midrib, passing into lateral wings of one layer of cells. *Geothallus* has a definite axis and leaves, while *Riella* has a membranous expansion of the wings on the dorsal surface of the midrib, and a row of leaves on both sides at the base of this expansion.

The *Acrogynae* form the great majority of the Hepaticeae. The plant is always divided into a distinct stem with leaves in the European

species, although in a few exotic species there is a thallus, but even in this case the branches bearing the sexual organs have a distinct stem and leaves.

The stems of the *Acrogynae* are composed of uniform tissue. The cells are generally smaller and with more thickened walls towards the periphery than in the centre, but this character varies, and is occasionally of service in distinguishing the species. On the ventral side there are nearly always smooth rhizoids which attach the plant to the substratum, and which also absorb water and soil, but in the genus *Radula* the rhizoids are attached to the postical lobe of the leaves; the rhizoids are frequently branched at the end, especially in epiphytic species where they only act as organs of attachment, and they very frequently spread out into a disk; they are most commonly colourless, but in some species are reddish.

The leaves are normally arranged alternately in a row on each side of the stem, giving the plant a flattened appearance, with frequently a third row of smaller leaves on the ventral side *(underleaves)*. There is a great diversity in the shape of the leaves; they may be entire, or lobed, the margins being variously dentate or ciliate, or they may be divided almost to the base. The lateral leaves may lie nearly in the same plane or they may be *complicate-bilobed*, i.e., the lobes will be folded, each with a separate attachment to the stem. In the former case there are two distinct methods of arrangement, viz., either the lower border of the leaf lies in front of the stem and covers the upper border of the next leaf immediately below it on the same side, as in *Plagiochila*, such leaves being named *succubous* [**83.** 1; **131.** 1.], or the upper border of the leaf lies in front of the stem (in this case being nearest the apex of the stem) and overlaps the lower border of the next leaf immediately above it on the same side, as in *Calypogeia*, such leaves being *incubous* [**185.** 1, 3]. These two arrangements are of much importance, and may be uniform through a genus, but are not always so. In the complicate-bilobed leaves the lobes may be equal in size and transversely inserted, as in *Marsupella*, but they are more frequently unequal; in the latter case, the dorsal lobe may be the smaller, as in most species of *Scapania*, the leaf arrangement being succubous [**221.** 1], or the dorsal lobe may be larger, as in *Radula*, the arrangement being incubous [**237.** 2.]. The leaves of Hepaticae are originally inserted transversely on the stem, but, by the unequal growth of the latter, they become oblique in most cases. The third row of leaves, the underleaves, are turned away from the light, and are in most cases much smaller and of a different shape from the lateral leaves. In a few species with erect stems, they are almost as large as the leaves, and occasionally of nearly the same form, and where the stem is prostrate in its lower part and almost without

underleaves, but erect towards the apex, they may be large and conspicuous in the erect position. In some genera various developments take place in the lateral leaves and even sometimes in the underleaves, for the storage of water.

The leaves are composed of parenchymatous cells without a distinct midrib, though in a few forms, as in *Diplophyllum albicans*, there is a median band of elongated cells, which serve for the conduction of water as shown by Tansley. The leaf-cells are nearly always in one layer, but are occasionally in two or more layers near the base. They vary from being roundish or polygonal to rectangular, and their walls may be thin or more or less thickened. This thickening may be equal round the cell or may only be found at the angles, and in a few cases there are intermediate thickenings between the angles. When the cells are more or less rounded off at the angles, the triangular thickened space between the cells is named a *trigone*. The trigones may be small, with concave boundaries [**75.** 3.], or they may be much enlarged, their boundaries becoming convex and projecting into the cell-cavity [**192.** 3; **195.** 3.]. In the growing cells the walls are thin, so that only mature cells show these characters. The outer wall of the cells on both surfaces passes gradually into a hyaline layer, the cuticle, which may be smooth, or verruculose, the verrucae being round to linear-oblong, or papillose [**180.** 3; **216.** 4.]. The cells contain many chloroplasts, and usually also oil-bodies, which vary in number and size and contain oil, a proteid substance, and water in the form of an emulsion.

The methods of branching of the stem in the *Acrogynae* are important. There are two principal forms, terminal or "end-branching," and intercalary. In order to understand the nature of the former it must be explained that the growing-point of the stem is a cell in the form of a pyramid, from which three segments are cut off. The two lateral segments go to form the leaves, after a part has been cut off for the construction of the stem, for which purpose each segment divides into a dorsal and a ventral cell. When a branch arises, it may be at the expense of the whole of the ventral cell, or of only a part. In the former case the dorsal lobe only of the leaf adjoining the branch is developed, as in *Frullania*, or, where the leaf has normally more than two lobes, as in the subgenus *Eulepidozia*, only a part is developed. In other cases, however, where, as in *Radula*, the whole of the ventral cell is not used up for the branch both lobes of the adjoining leaf are developed, though the ventral lobe may be diminished in size. Evans has recently shown that in the subgenus *Microlepidozia* it is the dorsal half of the lateral segment which is used up for the branch, and notes that in this case the incomplete leaf is placed on the ventral side of the base of the branch. As this end-branching takes place at the expense,

wholly or partly, of one of the leaf-lobes, it is always lateral and never axillary. Intercalary branching in the *Acrogynae* is usually ventral. The branch sometimes arises from a superficial cell of the stem, but is much more commonly endogenous. In the latter case the apical cell of the branch does not grow out at once as do lateral branches, but becomes covered with overlying cells which form a dome-shaped sheath through which it breaks later. Intercalary branching is characteristic of the flagella of *Bazzania*, and is also seen in most of the branches of *Cephalozia* and a few other genera.

The *Anthocerotales* are composed of thallose species which never have a distinct stem and leaves, and the midrib is rarely sharply defined from the lamina. The thallus of *Anthoceros* is several layers of cells thick in the middle, and usually thins out gradually to a one-stratose margin. It is formed of almost uniform tissue and without a special epidermis; in some species there are large intercellular spaces, or lacunae, which contain mucilage. Besides these lacunae there are cavities containing mucilage and *Nostoc* colonies, which open on the underside of the thallus by a stoma-like slit; they form small dark bluish-green round masses and can frequently be seen with the naked eye. The structure of the chloroplasts is peculiar and is not found elsewhere among the Bryophytes. In nearly every cell there is one large chloroplast, as in many of the green Algae; it is usually flattened, and is oval or roundish, with a nucleus. The thallus generally divides repeatedly in an irregularly dichotomous manner, forming a more or less complete rosette, and there are occasionally leaf-like outgrowths on the dorsal surface. On the ventral surface there are smooth rhizoids which attach the plant to the soil, and in some species there are tubers, especially where the plant occurs in dry situations.

Reproductive Organs

The reproductive organs of the Hepaticae are the antheridia or male, and the archegonia or female organs. The *antheridium* is generally spherical, or between this and oblong, and has a pedicel of about its own length or slightly longer or shorter. It consists of a wall composed of a single layer of cells investing a mass of sperm-cells, the mother cells of the spermatozoids, or antherozoids as they are sometimes named. The wall contains chlorophyll and is generally green, but may show a yellowish pigmentation when ripe. The wall, especially at its apex, and the mother-cells, become mucilaginous at maturity, and by the absorption of water the pressure increases until it ruptures the wall or throws off the apical cells, thus allowing the spermatozoids to escape. This may take place gradually, or sometimes in the *Marchantiaceae* by explosive discharges, as shown by Cavers. The full-grown

spermatozoid has a slender, twisted, thread-like body, usually showing about two spirals; it has two cilia at the forward end, and a small vesicle, which is the remains of the mother-cell but which often becomes detached, at the hinder end. The spermatozoid can move only in the presence of water by means of the cilia. The antheridium may be single or there may be several together; they are most frequently accompanied by small leaf-like or hair-like organs, named *paraphyses*.

The *archegonium* is a flask-shaped body, with a neck composed of a layer of cells which encloses a canal, and a venter which contains the egg-cell. When water is absorbed the canal-cells become mucilaginous, and excrete the mucilage, which apparently has a power of attraction for the spermatozoids; these pass down the canal, and one of them penetrates the egg-cell, fertilization being thus effected, the others dying. The archegonia usually occur in groups, seldom singly, and generally only one is fertilized, but even if more are fertilized, it is rarely that more than one comes to maturity. The egg-cell on fertilization begins to develop into the *sporophyte*. It undergoes division, but not on the same plan in all the orders. With the exception of the *Ricciaceae*, the bottom of the embryo develops into an absorbent organ, the *foot*, and the upper parts form the capsule, with usually a pedicel. While this cell-division is taking place, the cells of the wall of the *venter*, or lower portion of the embryo, also undergo division and develop into a protective covering, the *calyptra*, for the young sporophyte. In a few genera this protection is effected by other means, and a calyptra, in this limited sense, is not found.

The capsule or *sporogonium* remains inside the calyptra until it is mature. When favourable circumstances occur, the pedicel quickly lengthens by an elongation of its cells, causing the capsule nearly always to break through the calyptra, the latter remaining attached at the base of the pedicel. Further protection is generally given to the sporophyte by outgrowths either from the thallus or from the leafy stem. The capsule-wall is composed of one to several layers of cells, and within this is a mass of cells, some or rarely all of which produce spores, while others are sterile and these either remain as nutritive cells for the spores or, more commonly, some of them become elongated and have spiral thickened bands; these elongated cells are named *elaters*, and usually serve for the ejection of the spores from the capsule. The spores are more or less tetrahedral and are unicellular. They have two to three coats, the outer being usually thickened. The ripe capsule opens in various ways, either irregularly, or by the dehiscence of an apical cap, or most commonly by four valves.

The spore upon germination gives rise to a pro-embryo or protonema which is usually short-lived. It may be in the form of an

unbranched filament or germ-tube, the terminal cell of which gives rise to the young plant, or the filaments may be branched. In some cases the germ-tube is suppressed, and the protonema is in the form of a discoid cell-surface or a solid mass of cells. In the latter case, in the genus *Pellia,* this mass is formed within the capsule, and is mentioned in descriptions of the genus as a multicellular spore.

In the *Sphaerocarpaceae* each antheridium and archegonium has a special envelope which is formed from the thallus. The capsule contains nutritive cells and spores, but is without elaters; it grows faster than the calyptra and breaks through it before maturity. The spores are set free through decay of the wall, which is composed of one layer of cells without fibrous thickenings. In *Sphaerocarpus* the spores very frequently remain in tetrads, and it has been shown that commonly two of the spores of each tetrad form male plants and the other two form female plants.

In the *Ricciaceae* the antheridia and archegonia are sunk in the thallus, only the upper part of the neck of the archegonium being above the surface. The walls of the cavities which contain the antheridia are extended into a tubular neck, which reaches more or less above the surface. The capsule-wall is composed of one layer of cells, and absorbs nourishment throughout its whole surface, an absorbent foot being absent. The capsule only contains spores, these being comparatively few and large. The wall becomes disorganised, and the spores lie free in the calyptra until they escape through its decay and that of the thallus.

The *Marchantiaceae* have the antheridia and archegonia in groups, the single-layered capsule-wall has frequently fibrous thickenings, and elaters are nearly always present. In the *Targionioideae*, which differ considerably from the others, the male branches arise from the side of the midrib underneath, and have an expanded terminal disk, on the upper surface of which are small eminences, each with a canal leading to the pit which contains an antheridium. The archegonia are situated just behind the apex of the thallus, and are in two rows; from the base of each row a sheath arises and forms an envelope round the group, the two edges becoming interlocked. When the pedicel of the capsule enlarges it causes the capsule to burst the sheath open at the edges, and the capsule itself dehisces by its upper part being detached.

The archegonia of the *Marchantioideae* are borne on receptacles named *carpocephala*. These are outgrowths from the thallus, and consist of a cylindrical stalk and an expanded terminal portion. In course of time the archegonia become seated on the under surface of the terminal portion, and the stalk elongates. In some genera, an envelope

named the *pseudoperianth* is formed outside the calyptra for the protection of the archegonia. The antheridia are also collected on a receptacle which is generally stalked. They remain on the dorsal surface, and are not displaced to the ventral surface as in the case of the archegonia. Both the male and the female receptacles have generally well marked air-chambers which open on the surface, most commonly with barrel-shaped pores.

The archegonia of the *Jungermanniales* are never borne on a peduncled receptacle. This order is generally divided, according to the different position of the archegonia, into the *Anacrogynae* and the *Acrogynae*. In the former the archegonia are seated on the dorsal surface of the thallus or stem, so that the apical growth is not arrested. In the *Acrogynae* the archegonia are seated at the apex of the stem or branches, and as the apical cell is used up in the formation of the archegonia, the terminal growth is arrested. The two groups, however, are not sharply defined by this distinction; in *Calobryum*, one of the genera of the *Haplomitrioideae*, the archegonia are situated at the apex of the stem and the terminal growth is not arrested. Cavers, in fact, has given up this division of the *Jungermanniales* in his classification of the Bryophyta. He says in his *Inter-Relationship of the Bryophyta* that "we find among the *Anacrogynae* a series of types in which the development of the archegonia becomes, as it were, shifted nearer and nearer to the apex."

The *Anacrogynae* have the sexual organs sometimes developed on special branches, as in *Aneura*, where they are lateral, and in *Metzgeria*, where they are ventral. The archegonia are generally surrounded by an envelope which arises from the thallus, and which is of a different form in the various genera or even in the different species. This *involucre* is usually single and immediately surrounds the calyptra, but in some cases, as in *Moerckia*, an inner protective envelope, the *pseudoperianth*, also arises from the thallus, while in some others, as in *Fossombronia*, the young leaves generally protect the archegonia, and after fertilization a pseudoperianth is formed. In *Haplomitrium* there is no pseudoperianth, the protection being effected by a large calyptra. The capsule-wall has more than one layer of cells, the inner layer having usually transverse thickenings, except in the *Haplomitrioideae*, where the wall has only one layer of cells and the thickenings are longitudinal. In a few genera there are *elater-bearers* or elaterphores as well as the free elaters. A mass of tissue just within the capsule-wall and continuous with it becomes sterilized and forms elater-like cells. These "fixed elaters" or elater-bearers are either in a tuft at the base of the capsule, as in *Pellia*, or they are at the apex, as in *Aneura* and *Metzgeria*, where

they separate into four tufts and remain attached to the apex of the valves on dehiscence. They assist in the dispersal of the spores. A few fixed elaters also occur in some other genera. The antheridia are arranged either in groups, generally in two rows, and usually protected by a scale-like covering, or they are irregularly scattered as in *Pellia*, where they are sunk in cavities on the dorsal surface of the thallus, and in *Fossombronia*, where they lie on the stem close to the base of the leaves, and are either naked or protected by a scale.

The archegonia, with the calyptra, are protected in the *Acrogynae* by more or less modified leaves, the *bracts*, and nearly always also by modified underleaves, the *bracteoles*. The bracteoles are usually present whether there are underleaves on the stem or not, but in some genera they are absent; they are larger than the stem underleaves, being sometimes nearly as large as the bracts, to which they are frequently joined at the base on one or both sides. In some cases they are joined to the bracts for a considerable distance, forming an *excipulus*. The bracts are generally larger than the leaves and have a tendency to be more lobed, and with the margins more strongly armed in the dentate species; they never develop special structures such as water-sacs. The bracts and bracteole form the exterior involucre, the uppermost pair of bracts being the *involucral bracts*, the lower pair or more being the subinvolucral bracts or leaves. In most cases a special protective envelope arises within this involucre during the development of the archegonia. It commences as an annular ring at their base, and grows into a tubular sheath which is open at the apex, forming an inner involucre. It is named the *perianth*, and although its production is generally independent of the archegonia being fertilized, it seldom reaches its normal form in sterile plants. It is usually free from the bracts, but in some cases is more or less highly joined to them. The perianth is generally considered to be formed by the concrescence of two leaves, or of two leaves and an underleaf, though Goebel thinks it to be more probably the descendent of an organ present in thallose ancestors. If two leaves and an underleaf, remaining flat, are joined together, the resulting perianth will form a triangular prism, one of the flat sides being ventral and the other two lateral, the junction of the two lateral sides forming a dorsal angle; this is named the "epigonianthous" type, and is well seen in *Lophocolea*. If the two leaves and an underleaf are folded, instead of being flat, the keel of the fold will form one of the keels of the perianth, so that one of the angles will be ventral; this is the "hypogonianthous" type, as in *Cephalozia*. When no underleaf takes part in the formation of the perianth, there are also two forms. If the two leaves are flat, the perianth will be compressed laterally, as in *Plagiochila*, and if the leaves are folded, the compression will be dorsi-ventral, as in *Scapania*. This

formation of the perianth from leaves can be sometimes almost demonstrated, as in *Lophocolea*, but in other cases such derivation is obscure and doubtful, as when there are more than three angles, or when the angles are absent altogether. A perianth is not always present. In *Gymnomitrium* the protection of the archegonia is effected by the bracts, with the calyptra; in other cases this protection is given by the stem, so that the perianth may be rendered unnecessary, and rarely also the calyptra. The amount of protection afforded by the stem varies greatly, and is effected in various ways. The absorbing foot of the young sporophyte may penetrate more or less deeply into the stem tissue; the tissue may remain unaltered or nearly so, or grow in thickness, and in the process of growth it may rise up around the young sporogonium, which will thus lie in a hollow tube, named a *perigynium* or *marsupium*. This may continue in the direction of the axis of the stem, or grow downwards as well and root in the ground, or the growth may be entirely downward. In the latter case the perianth is rarely present, not being required. Different stages in the formation of a perigynium may be seen in our species from *Alicularia Geoscyphus* to *Calypogeia*.

The capsule-wall of the *Acrogynae* has always more than one layer of cells. Most frequently there are only two layers, but not uncommonly there are several, the inner layer having generally spiral thickened bands in its cell-walls. The wall nearly always divides to the base, or almost so, by four valves, but in the *Jubuloideae* there is a solid mass of tissue at the lower third of the capsule, as in the apophysis of a moss, and the valves do not separate below this. The spores and elaters may be arranged within the capsule irregularly, or the elaters may have a tendency to regularity. The latter is most marked in the *Jubuloideae*, where they have a definite arrangement, being fixed by their upper ends to the roof of the wall, and extending to the bottom where their ends are less firmly fixed; in this subfamily they have only one spiral, while in the others they have two or more. The pedicel of the capsule is delicate as in other Hepaticae. Douin in *Bull. Soc. Bot. de France* p. 194, 1908, has investigated the arrangement of the cells in some genera, and gives various types. Spruce had previously demonstrated the arrangement in the *Jubuloideae*.

The antheridia are very commonly in groups of two to four, but they are often solitary, or the groups may contain more than four. They are frequently accompanied by hair-like or foliar paraphyses, and are borne in the axils of more or less modified leaves, the *perigonial* or male bracts. Very rarely are antheridia also present in the axils of the underleaves. The bracts are nearly always in several pairs, and closely imbricated, transversely inserted, and ventricose at base, and they are most frequently bilobed with the lobes nearly equal and often with a

tooth on the antical (dorsal) margin. They may be terminal or intercalary on ordinary branches, or they may be on special catkin-like branches. In some cases they occur below the female inflorescence, occupying the axils of the subinvolucral bracts, which in this case are frequently more or less saccate and otherwise modified, usually making this "paroicous" form of inflorescence (see below) easy to recognize.

The sexual organs of the *Anthocerotales* differ considerably from those of the previous orders. They are sunk in, and continuous with, the thallus from the first. The sporophyte develops a large, absorbent foot with suctorial tubes which pass into the thallus, and in addition, the capsule, which in *Anthoceros* is long and cylindrical and without a pedicel, and has a many-layered wall of assimilative tissue with air-chambers, and with stomata like those of mosses and vascular plants in its epidermis. The capsule is thus not entirely dependent for nourishment on the thallus as in the other orders, and its growth is not stopped when the first spores have ripened. The embryonic cells below the capsule, which are continuous with it, continue to grow indefinitely, the capsule thus growing at the base while the spores are ripening at the apex. In the centre of the capsule is a slender *columella* which not only strengthens the capsule and holds the spores and sterile cells in position, but serves for the conduction of the water and salts which are absorbed by the foot. As the spores gradually ripen from the apex downwards, the capsule splits into halves, leaving the hair-like columella projecting. The sterile cells are named *pseudo-elaters* and are composed of one or more cells which rarely in our species show a rudimentary spiral thickening. The antheridia are generally in groups of two to five in closed cavities near the dorsal surface of the thallus. They are endogenous in their origin, arising within the thallus. The cavity has a roof of two layers of cells which become ruptured, leaving the mature antheridia exposed.

The relationship of the antheridia and archegonia to each other on the same or on different plants is denoted by various terms. The inflorescence is said to be—

Synoicous.—When they are mixed together within the same involucre. This very rarely occurs in Hepaticae.

Paroicous.—When the antheridia are below the archegonia on the same stem or branch [**86.** 1; **99.** 1; **143.** 1.].

Monoicous.—When they are on the same plant but on different branches [**25.** 1; **141.** 1; **154.** 1.].

Heteroicous.—When the plant is sometimes both paroicous and monoicous.

Dioicous.—When the antheridia and archegonia are on separate plants [**29.** 1, 2; **35.** 1, 5; **159.** 1, 6.].

Polyoicous.—When they are sometimes on the same plant and sometimes on different plants.

Vegetative Reproduction

This method of propagation is very common in the Hepaticae, and in some species it is the usual means of increase. In its simplest form the older parts of the gametophyte die, and the younger parts, on separation, form independent plants; this can be frequently seen in creeping species In other cases small branchlets are formed by the repeated forking of the vegetative point, and become detached, as in *Pellia Fabbroniana*. A very common method of increase is by adventive branches or by gemmae.

The thallose species increase chiefly by the independent growth of young branches which have separated from the dying older parts, and by adventive shoots which usually arise from the ventral surface of the midrib These adventive branches occasionally arise from the margin of the thallus, as in *Aneura*, or even from the dorsal or ventral surfaces of any part of the thallus, as in *Metzgeria*. Gemmae are uncommon in thallose species, and are found, in the *Marchantiales*, only in *Marchantia* and *Lunularia*, where they occur in special receptacles on the dorsal surface of the thallus. They are seen in a few genera of the *Anacrogynae*, being endogenous in *Aneura*. In some species of *Metzgeria* they are frequent and arise from various positions, sometimes being on specialized gemmiferous branches. In *Blasia* they occur as stellate scales on the dorsal surface, and as a mass of cells in flask-shaped receptacles.

Increase by separation of young branches, adventive or normal, from the older parts, as well as by gemmae, is common in the *Acrogynae*. Small caducous branchlets also, named "propagula," are seen in some species, and caducous leaves occur in several. The tendency to vegetative propagation is so strongly developed in Hepaticae that it is considered that every cell of the gametophyte has the latent power of producing a new individual. Gemmae are common, but do not occur in all genera They are usually more or less spherical, or sometimes angular, and are 1–2-celled, but they may be discoid and many-celled, as in the *Jubuloideae* and a few other cases. The discoid gemmae are usually situated on the surface of the leaf, to which they may be attached by a stalk, but the others are found on the margins, where they hinder the development of the leaf This arrest is frequently well marked on the upper leaves, which may become deformed, and at the apex of the stem the gemmae may take the place of the leaves by

being formed from the apical cell. In some species, as in *Calypogeia*, they form masses at the summit of shoots which become erect. Gemmae are frequently copious in plants when under unfavourable conditions, and it is seldom that they occur in quantity on fertile plants. The development of the gemmae conforms in great measure, and sometimes at least identically, with that of the spore in the process of germination.

Collection and Examination

This subject has been frequently dealt with, and few remarks need be made. The great majority of Hepaticae are confined to stations where transpiration is not excessive. They are common in the wetter parts of the country, and scarce in the drier parts. In the former they are found in exposed as well as sheltered places, but in the drier districts they require some degree of shelter, except in the case of the few xerophytic species, or where the soil is permanently moist. They are, in general, scarce in the region of cultivation, this being a district of small rainfall, but they will be found in quantity in the wetter sub-alpine and alpine regions, especially on the north and east sides of the hills where there is more permanent moisture. The typical forms, at least, of most of the species, can be recognized in the field by the experienced student, but the beginner will acquire this knowledge only after studying them at home with the microscope. It is important when searching for hepatics that the pocket lens should have a large field. Not only will the student be able to recognize the plant again in a shorter time than if a more powerful lens were used, but he will be able to detect an admixture of species, if present, more readily. After some experience many of the species will be recognized by their habit or colour, though the student will not rarely be surprised at the resemblance one species may take to some other when only looked at *in situ*. The more critical, as well as many of the smaller species, can rarely be recognized with certainty in the field, and of course, only a very superficial knowledge of any species can be gained without microscopical examination. Plants with perianths should be sought for when possible, as their presence will frequently greatly assist, and may even be necessary before the genus can be determined.

For the examination of a specimen, a small tuft is placed in a saucer with water and gently kneaded with the fingers to remove the soil and air-bubbles. If there be much soil, a second saucer of water may be required. The tuft should be examined with a pocket lens when in the water, and again after it has been taken out and partially dried with a towel. This will show several of its characters, as well as assist in recognizing the plant afterwards in the field. Part of the tuft is then placed under the dissecting microscope, and after adding a drop

of water, an entire plant is separated from the tuft; this is important, otherwise the inflorescence (if present), which may be characteristic of the plant, may not be noted. If it be a large species, this separation of an entire plant must be done in the saucer. Scalpels are sufficient to separate the plants, except in the case of small species, where needles must be used. In very delicate species, camel-hair brushes may be found preferable to needles. A few mature leaves must then be dissected off the stem, except with minute species, in order to learn their form. A piece of stem with leaves attached, as well as a slide with the detached leaves, should be examined under a low power of the microscope, and afterwards under a higher power. For the cell-structure, leaf-cuticle, spores, etc., the higher power is necessary, but a magnification above 240–300 diameters is seldom necessary.

Classification and Nomenclature

The Hepaticae are a plastic group of plants, and the genera are comparatively seldom sharply isolated. The species also, though some of them vary only to a small extent, as a rule vary considerably. The beginner will often be puzzled at the different values given in books to species and varieties, but these different values are in great measure owing to the different views which the writers hold as to what constitutes a "species" or a "variety." If a "species" be understood as a group of forms more or less sharply separated from another group of forms, not necessarily of equal value, it is only to be expected that, in dealing with a somewhat primitive and plastic class like the Hepaticae, a larger number of the species will be found without sharply defined limits, than when dealing with a more stable and advanced class of plants. This consideration makes the separation of these plants into species and varieties more open to a difference of opinion. A "variety" may be considered as a deviation from the normal or typical form of the species, with characters which are to some extent constant, and it must be largely a matter of personal opinion as to what amount of constancy of characters will entitle a plant to be placed in this particular category.

A species varies in different directions, and the most important matter to learn is the "form-circle" of each, if possible. In order to acquire a more than elementary knowledge of the subject, the student must guard against dismissing "off-type" specimens as being "merely a form" of some well-known species. Hepaticae are by no means an easy class of plants to acquire a knowledge of, and the difficulty is increased when one finds that two allied species vary in parallel lines, so that the student may think that they have intergraded when such is not the case. Two deviations, which will be constantly met with, from the normal plant, may be mentioned. If the plant is in a position where

it cannot obtain its normal amount of nourishment, and especially moisture, it will be smaller and weaker than the type, the stems being shorter and the leaves frequently deformed; this is a *depauperate* form. Fruit is not uncommon in this form. The other deviation is when the plant has a deficiency of light. Under this condition it is generally green or pale green, the stems are elongated and thin, the leaves distant, smaller, and with thinner cell-walls, and if it be a thallose species the branches have a tendency to grow erect; this is an *etiolate* form. In such plants fruit rarely occurs, but gemmae are often abundant. These etiolated forms may only differ slightly in appearance from the typical plant, or they may do so greatly, as in the case of a *Gymnomitrium* with normally short stems and closely imbricated leaves having elongated stems and the leaves distant. Much matter of interest in the relation of the morphology of Hepaticae to surrounding factors will be found in Goebel's *Organography of Plants*.

The system of classification adopted in this book is mainly that of Schiffner in Engler and Prantl, *Die natürlichen Pflanzenfamilien* (1893-1895), but some changes with respect to the subfamilies and lower groups, especially as regards their nomenclature, have been necessary in order to bring these into accord with the *International Rules for Botanical Nomenclature*, adopted at the Vienna Congress in 1905. The Rule making the year 1753 the starting-point for botanical nomenclature, which was definitely accepted for the Hepaticae at the Brussels Congress in 1910, has involved the disappearance of some names, familiar to English students, which had been adopted on the authority of earlier writers, such as Dillenius and Micheli. The main divisions of the Acrogynae were originally proposed by Spruce in *Hep. Amaz. et And.*, but in his view the *Jubuloideae* were equivalent in rank to the remainder of the *Jungermanniales*. In raising the *Sphaerocarpales* to ordinal rank I have followed Cavers in *The Inter-Relationships of the Bryophyta*. The descriptions of the higher groups, and of the genera, are taken in great part from Schiffner's above-mentioned work, with assistance from the writings of Douglas Campbell, Cavers, Evans, Howe, K. Müller, Spruce, and Stephani.

The method of indicating the distribution of each species is founded on that of Hooker's *Student's Flora of the British Islands*. A more detailed county distribution will be found in the *Moss Exchange Club Census Catalogue of British Hepatics*. The distribution of varieties is seldom given, as little attention has hitherto been paid to them in Britain, and to give the limited distribution at present known would only be misleading. In the few cases, however, where the distribution of a variety is given, it includes all the districts from which the writer has specimens in his herbarium.

CONSPECTUS

Order I.

SPHAEROCARPALES

Gametophyte a tender thallus with, in addition, or without leaves on the axis, or a stem with distinct leaves. Air-chambers and pores absent. Rhizoids smooth. *Each antheridium and archegonium provided with a special envelope.* Embryonic development as in *Marchantiales*. Sporogonium, with very short pedicel and large foot, of one layer of cells without fibrous thickenings, dehiscing irregularly. *Sterile cells not developed as elaters.*

Family I. SPHAEROCARPACEAE

Thallus (in *Sphaerocarpus*) without a distinct midrib, of one layer of cells towards the margin, almost hidden by closely grouped pear-shaped or conical involucres in which are found the sexual organs. Spores usually permanently united in tetrads.

Order II.

MARCHANTIALES

Gametophyte a *thallus composed of several distinct layers of tissue*, of which the uppermost, the chlorophyll-bearing layer, nearly always encloses air-chambers. *The dorsal epidermis usually with pores;* the ventral side with scales in rows. *Rhizoids of two kinds always present*, smooth and tuberculate (with internal peg-like papillæ). *Sexual organs, except in the lowest forms, united in a receptacle which is often on a long peduncle.* The first divisions of the embryo arranged like the

quadrants of a sphere. Sporogonium either without a foot or pedicel, with all the inner cells forming spores, or with a foot and pedicel, with the inner surface forming sterile cells, usually developed as elaters, as well as spores. No columella present.

Family II. RICCIACEAE

Chlorophyll-bearing layer with narrow air-spaces, or with larger chambers without a specialized assimilative tissue. Pores absent or rudimentary. *Antheridia and archegonia immersed singly in cavities of the dorsal surface.* Sporogonium without a foot or pedicel and remaining enclosed in the calyptra, its delicate *wall later disappearing, the ripe spores lying free in the archegonial cavity. Sterile cells absent.*

Family III. MARCHANTIACEAE

Chlorophyll-bearing layer nearly always *with highly developed air-chambers*, from the floors of which arises a filamentose assimilative tissue. *Pores* (except in *Dumortiera*) *always present. Sexual organs always in groups, frequently on long peduncled capitate receptacles. Sporogonium with foot and pedicel*, the mature capsule breaking through the calyptra and *dehiscing by teeth or a lid*, rarely by 4–8 valves. *Sterile cells*, usually developed as elaters, *always present*, as well as spores.

Subfamily Targionioideae

Sporogonium solitary, sessile on the underside of apex of thallus, surrounded by a 2-valved involucre. Elaters 2–3-spiral, frequently branched. Antheridia on the upper surface of small disciform innovations.

Subfamily Marchantioideae

Sporogonia aggregated on the under side of a peduncled receptacle (carpocephalum).

Marchantioideae-Operculatae

Areolæ on the dorsal surface of the thallus indistinct. Air-chambers becoming undefined through the formation of secondary walls Apical portion of the capsule at dehiscence falling off as a cap or in fragments, the under part remaining behind as an urn-shaped cavity; capsule-wall without semi-annular thickenings.

Usually only one archegonium developed in each involucre of the receptacle.

Marchantioideae-Compositae

Areolæ on the dorsal surface of the thallus distinct. Air-chambers (except in *Dumortiera*) well defined, rarely divided by secondary walls. Capsule usually dehiscing by irregular valves, the wall with semi-annular thickenings (except in *Lunularia*). Usually more than one archegonium developed in each involucre of the receptacle.

Order III.

JUNGERMANNIALES.

Gametophyte a thallus, with or without a midrib, *never differentiated into distinct layers of tissue;* or a cylindrical leafy stem. Between these are intermediate forms. *Rhizoids always smooth. Pores never present.* The first division of the embryo transverse, the lower of the two cells seldom taking any further part in the development of the sporogonium. Sexual organs arranged in groups, but *never in special peduncled receptacles* and rarely immersed. Sporogonium with pedicel and foot, the mature capsule breaking through the calyptra and *dehiscing almost always by four valves.* Sterile cells, developed as elaters, always present, as well as spores.

Fam. IV. JUNGERMANNIACEAE ANACROGYNAE

Gametophyte *generally a thallus*, more rarely a stem with leaves. *Archegonium arising from behind the apical cell* (except in *Calobryum*), the sporogonium being therefore dorsal, or only apparently terminal. Involucre of the sexual organs *never representing leaves.* To this group belong all the thallose and intermediate forms, and the foliose but multilateral and aberrant genera *Haplomitrium* and *Calobryum.*

Subfamily **Metzgerioideae**

Thallus fleshy or membranous, frequently with a sharply defined midrib and a lamina composed of one layer of cells. ♂ *and* ♀ *inflorescence on very short branches which form the receptacle*, the ♂ as well as the ♀ being arranged more or less regularly in two rows on the upper side of the branch. Capsule ovate or cylindrical, 4-valved, composed usually of two layers of cells, of which the inner possesses more or less distinct semi-annular thickenings. Elaters either attenuate at each end and with *one broad spiral thickening*; or *as elater-bearers*, short and obtuse, with an indistinct spiral thickening, and *persistent as erect tufts at the apex of the valves.*

Subfamily **Dilaenoideae**

Thallus with a distinct and usually sharply defined midrib, ♂ and ♀ inflorescence *on the dorsal surface of the thallus*, not on special branches, the archegonia in groups. *Involucre double* (in the European genera) or single. Capsule generally *cylindrical*, never spherical, usually dehiscing incompletely by 2–4 valves, the inner wall *without semi-annular thickenings.*

Subfamily **Codonioideae**

Thallose, *foliose*, *or forms intermediate* between them. In the foliose forms the leaves are in two rows, parallel to the stem or obliquely inserted and succubous, simple (never bilobed). Rhizoids always present. ♂ and ♀ inflorescence scattered, or in groups, on the dorsal surface. ♀ *involucre single* (in the European genera), rarely double. Capsule usually longly pedicellate, *globose* (oval in *Blasia*), dehiscing to the base by 4 valves or irregularly, the wall of two or more layers of cells, the inner *nearly always with semi-annular thickenings.* Elaters adherent *to the base of the capsule* or partly free, more rarely altogether free, 2–4-spiral.

Subfamily **Haplomitrioideae**

Stems erect, arising from a fleshy rhizomatous-like basal portion. *Leaves arranged radially* and more or less regularly in three rows, simple (not bilobed). *Rhizoids absent.* ♀ inflorescence on the upper part of the stem, without an involucre. Calyptra large, cylindrical. Capsule cylindrical, the wall of one layer of cells except at the apex, with *longitudinal* annular thickenings. Elaters bispiral.

Family V. JUNGERMANNIACEAE ACROGYNAE

Gametophyte a stem *with two lateral rows of leaves* and frequently a third postical row. *Archegonium arising from the apical cell*, the sporogonium being therefore terminal on the stem or branches The involucre (perianth) *representing true leaves.*

Subfamily Lophozioideae

Plants usually large, rarely small. Stems irregularly branched, very rarely pinnate; branches almost always lateral. *Leaves succubous or transversely inserted*, entire or 2-lobed, seldom 3–5 lobed, the antical portion being often much recurved. Underleaves generally absent or small, very rarely large. Inflorescence acrogenous, very seldom cladogenous. *Perianth* (when present) *normally compressed from the side*, cylindrical, or ovate and plicate, or trigonous with *the third angle always antical.* Some genera marsupial. Capsule mostly ovate or cylindrical, 4-valved to the base. Elaters deciduous, attenuate at both ends, normally bispiral. Androecia very seldom on special branches; bracts with 1–10 antheridia.

Subfamily Cephalozioideae

Leaves frequently incubous, more or less deeply divided at the usually broad truncate apex into 2–4, or rarely 6 teeth or lobes, seldom quite entire, the margin never recurved. Underleaves mostly present and small, rarely nearly as large as the leaves. ♀ *inflorescence cladogenous, on postical branches*, seldom on lateral, or acrogenous; *bracts usually tristichous.* Perianth generally long and narrow, *trigonous with the third angle postical*, rarely 4–6 angled. One European genus (*Calypogeia*) marsupial. Capsule 4-valved with straight valves (in *Calypogeia* twisted). Elaters bispiral. Androecia very often on small postical branches; male bracts monandrous, very rarely diandrous.

Subfamily Ptilidioideae

Leaves incubous or transverse, seldom succubous, bi–multifid, *frequently ciliate or ending in hair-like points.* Underleaves always present and *nearly resembling the leaves in shape and size.* ♀ inflorescence *terminal on the stem or on lateral branches, never on postical branches*; bracts polyphyllous. Perianth scarcely compressed, 3–10 plicate, contracted or truncate at the mouth, free or adnate with the innermost bracts, sometimes absent. Capsule usually shortly

pedicellate, ovate with straight valves or cylindrical with twisted valves.

Subfamily **Scapanioideae**

Stems arising from a creeping rhizome; branches few, lateral, seldom one or more sub-floral innovations which are postical. Leaves alternate, transverse, *complicate-bilobed, the antical lobe smaller than the postical*, margins *usually dentate or ciliate*, keel nearly always present, frequently winged. Underleaves absent, or in a few instances present and not resembling the leaves. ♀ inflorescence acrogynous. Perianth, when present, free, frontally compressed, or sub-inflated and 4–pluriplicate. Capsule 4-valved to the base. Elaters bispiral.

Subfamily **Raduloideae**

Plants rather large, rarely small, usually forming depressed patches. Stems arising from a rhizomatous base, prostrate, laxly pinnate or sub-pinnate, branches all lateral and *infrafoliar* in origin. Leaves incubous, *complicate-bilobed*, margins nearly always entire, *the postical lobe smaller* with its free margin generally appressed to the underside of the antical lobe, *the rhizoids arising from a mamilliform protuberance near its fold. Underleaves everywhere absent.* ♀ inflorescence acrogenous, frequently with 1–2 sub-floral innovations, very rarely cladogenous. Archegonia 5–16. *Perianth usually strongly frontally compressed*, rarely sub-terete, very rarely plicate, *the mouth wide, truncate, bilabiate.* Capsule shortly and stoutly pedicellate, generally oval-cylindrical, 4-valved to the base, the walls of two layers of cells. Spores large, globose. Elaters long, slender, obtuse, closely bispiral. Androecia spicate, usually terminal on the branches, bracts with 1–2, rarely 3 antheridia. Gemmae discoid, arising from the margin of the leaf.

Subfamily **Pleurozioideae**

Plants usually *large*, pale or brown, *very often purple*, with erect stems from a rhizomatous base, branches lateral. Leaves incubous, rarely undivided, nearly always 2-lobed, the antical lobe entire or dentate, the postical lobe smaller, *saccate*, with its base on the postical side of the stem and attached to the lower part of the antical lobe, *its narrow mouth often closed by a complicated valve apparatus.* Underleaves absent. ♀ and ♂ inflorescence on short lateral branches. Perianth *elongate and narrow*, generally 4–10-plicate

from the middle, the mouth contracted, ciliate-dentate. Capsule oval, 4-valved to the base. Elaters decidcus, bispiral. "Sterile perianths" on short branches, cylindrical, smooth, the mouth wide, circular, entire, the margin incurved. Androecia small, spicate, bracts 6–12 pairs, imbricate, monandrous.

Subfamily Madothecoideae

Dioicous. Plants large, green or brown. Stems arising from a rhizomatous base, usually *regularly bi- or tri-pinnate*, the branches lateral; rhizoids scarce, arising from the base of the underleaves. Leaves incubous, *complicate-bipartite almost to the base*, the antical lobe large, sub-ovate, entire or dentate, *postical lobe much smaller, ligulate, linear or ovate*, nearly parallel to the stem and frequently decurrent at the external base. *Underleaves everywhere present, resembling the postical leaf-lobe, but broader*, frequently decurrent at the base on both sides. ♀ *inflorescence terminal on very short lateral branches;* bracts usually a single pair, almost always dentate or ciliate. Perianth sub-oval, somewhat frontally compressed, trigonous in section, the mouth *becoming bilabiate or campanulate* by the extrusion of the capsule. Calyptra of several layers of cells. Capsule shortly pedicellate, globose, 4-valved, the valves often irregularly slit and *rarely separating down to the base*. Elaters short, 2–3-spiral. Androecia shortly spicate, terminal on short lateral branches, bracts nearly equally bilobed, exactly opposite and connate with the underleaves; antheridium almost constantly solitary.

Subfamily Jubuloideae

All branches lateral. Leaves alternate, *incubous, complicate-bilobed, the postical lobe (lobule) smaller, usually inflated or saccate.* Underleaves nearly always present with rhizoids in clusters from close to their base. ♀ *inflorescence monogynous or 1–4-gynous*, very rarely more, terminal on the main stem or principal branch or sometimes on a short special branch. Perianth free, more or less frontally compressed, 2–12 angled, rarely terete, *the apex constricted into a short tubular mouth.* Calyptra free. Capsule on a short pedicel, globose, 4-valved for $\frac{2}{3}$ *of its length, the lower third solid. Elaters few, monospiral, attached to the inside of the capsule-wall by their upper ends and extending to the floor of the capsule, their lower ends trumpet-shaped and becoming free.*

Order IV.

ANTHOCEROTALES

Gametophyte a *thallus* with pores on the ventral, and sometimes also on the dorsal, side. *In each cell is one large chloroplast.* Rhizoids smooth. Antheridia arising *endogenously*, sunk in cavities near the dorsal surface. Sporogonium *pod-like with a bulbous foot but without a pedicel*, its walls with chlorophyll and *having stomata.* The mature capsule dehiscing from the apex downwards by two valves. *A central columella developed, its apex being arched over by the spore-forming layer.* With the spores are (in our species) *angular bent sterile cells* (pseudo-elaters).

Family VI. ANTHOCEROTACEAE

Characters of the Order.

Order I.

SPHAEROCARPALES

Family I. SPHAEROCARPACEAE

Thallus (in *Sphaerocarpus*) without a distinct midrib, of one layer of cells towards the margin, almost hidden by closely grouped pear-shaped or conical involucres in which are found the sexual organs. Spores usually permanently united in tetrads.

The *Sphaerocarpales*, as defined by Cavers, whose classification I have followed with this Order, contains the *Sphaerocarpaceae*, comprising the genera *Sphaerocarpus* and *Geothallus*, and the *Riellaceae*, comprising the genus *Riella*. This group shews affinities with both the *Marchantiales* and the *Jungermanniales*, and has been variously placed in one or the other, but Cavers points out that the group has special characters of its own, which do not occur elsewhere among the *Hepaticae*, as in its having a special envelope around each antheridium and archegonium. (See Cavers, *The Inter-Relationship of the Bryophyta*, New Phytologist 1910-11.)

I. SPHAEROCARPUS Ludwig

Sphaerocarpos Mich., Nov. Pl. Gen. p. 4 *pl.* 3 (1729).
Sphaerocarpos Ludwig, Def. Gen. Pl. p. 501 (1760).
Sphaerocarpus Adans., Fam. Pl. 2 p. 14 (1763).

Dioicous. Thallus small, *many-lobed, orbicular to cuneate*, without a distinct midrib, the lobes unistratose except at base. ♀ involucres covering *almost the entire dorsal surface of the thallus, clavate to pyriform*, with an orifice at the apex, *each enclosing one* nearly spherical capsule closely invested by the calyptra. Capsule cleistocarpous, the wall of one layer of cells without thickenings. Spores large, areolate, nearly always remaining *permanently in tetrads*. Sterile cells *not developed as elaters*, but as small spherical starch-bearing cells. ♂ plants much smaller than the ♀ ; antheridia nearly spherical,

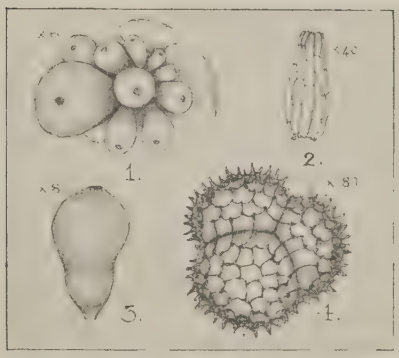
shortly pedicellate, enclosed in small conical or flask-shaped involucres scattered over the dorsal surface of the thallus.

Miss C. C. Haynes in her Monograph of the genus (Bull. Torr. Club p. 215-230, 1910) gives six species as the number at present known.

{Tetrads 80-110 μ in diam., with 8-10 areolae across the face, 8-14 μ in diam. *1. Michelii*
Tetrads 120-150 μ in diam., with 5-7 areolae across the face, 15-24 μ in diam. *2. texanus*

1. Sphaerocarpus Michelii Bellardi

Sphaerocarpos terrestris minima Mich., Nov. Pl. Gen. p. 4 *pl.* 3 (1729).
Targionia Sphaerocarpos Dicks., Pl. Crypt. Fasc. 1 p. 8 (1785).
Sphaerocarpos Michelii Bellardi, App. ad Fl. Pedem. p. 52 (1792).
Sphaerocarpus terrestris Sm., Eng. Bot. *pl.* 299 (1796).
Sphaerocarpus Sphaerocarpus M. A. Howe, Mem. Torr. Club 7 p. 66 (1899).



1. Plant. 2. Male involucre. 3. Female involucre. 4. Tetrad.

Dioicous. In *small circular pale glaucous-green patches* 5-15 mm in diam. Thallus prostrate with rounded lobes, in section 4-5 cells thick in the middle, with uniform cells, gradually passing into the lobes which are 2-3 cells thick at the base, otherwise unistratose; rhizoids numerous from the middle of the thallus, long and colourless. Cells 5-6-angled with thin walls, becoming quadrate on the margin of the lobes. ♀ involucres *pyriform to obovoid*, green, of one layer of cells, the lower cells elongate, mostly rectangular, the upper 5-angled with brown walls, margin of orifice entire. Tetrads *80-110* μ in diam., dark brown with lamellae forming distinct hexagonal areolae *8-14* μ in diam., *8-10 in number* across the face of the tetrad, appearing shortly *spinous* on the margin. ♂ plant very small, 1 mm in diam.; involucres flask-shaped, *tinged with red*, more than twice as long as broad when mature.

Hab. Usually in clover and turnip fields on loam and clay soils.

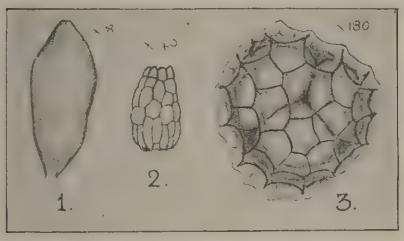
Distrib. From south-east Yorkshire southd.; rare. Fr. Nov-June.

A minute plant at once known, except from the following species, by the numerous pyriform involucres covering almost the entire dorsal surface of the thallus. The ♂ and ♀ plants generally grow together; the former is much the smaller, being hardly visible to the naked eye, but can be recognised by its red tinge.

Miss C. C. Haynes mentions that occasionally an isolated median papilla is seen in the areolae of the spores of this and the following species. It likewise appears from her researches that the present plant has not been found in America, the specimens under this name being usually the more widely distributed *S. texanus*.

2. Sphaerocarpus texanus Aust.

Sphaerocarpus texanus Aust., Bull. Torr. Club 6 p. 158 (1877); C. C. Haynes, Bull. Torr. Club 37 p. 222 *pl.* 26 and 27 (1910).
Sphaerocarpus californicus Aust., Bull. Torr. Club 6 p. 305 (1879).



1. Female involucre. 2. Male involucre. 3. Tetrad.

Differs from *S. Michelii* in the spore-tetrads being much larger and with quite different sculpture, viz., *120-150 μ in diam.*, the areolae *5-7 in number* across the face of the tetrad, *15-24 μ in diam.* and always distinct, the margin appearing *crenulate, not spinous*, the entire surface minutely granulate; ♀ involucre *fusiform-clavate*, the mouth frequently crenulate; ♂ involucre one and a half to twice as long as broad when mature.

Hab. As in *S. Michelii*, with which it sometimes grows in company.

Distrib. Surrey, Gloucester, Worcester; rare. Fr. Nov-June.

The shape of the ♀ involucre does not appear to be a character of great importance for distinguishing the two species; nor does the orifice being entire or crenulate seem to be a dependable character.

The spores are very distinct and form an easily distinguishable and reliable character in separating the species. In *S. texanus* the ridges which form the areolae are only slightly elevated at the angles, so that in profile the spores appear as if crenulate. In our other species the angles are raised into spines, the profile being thus spinous. In both species the spores are permanently united in tetrads.

Miss Haynes has shown in her Monograph of the genus the identity of *S. texanus* and *S. californicus* Aust., also that this species was collected in Europe as long ago as at least 1834. It was not, however, recognised as European until Douin re-found it in 1907.

Order II.

MARCHANTIALES

Family II. RICCIACEAE

Chlorophyll-bearing layer with narrow air-spaces, or with larger chambers without a specialized assimilative tissue. Pores absent or rudimentary. *Antheridia and archegonia immersed singly in cavities of the dorsal surface.* Sporogonium without a foot or pedicel, and remaining enclosed in the calyptra, its delicate *wall later disappearing, the ripe spores lying free in the archegonial cavity. Sterile cells absent.*

{ Epidermis without pores; antheridia scattered in the thallus .....*II. Riccia*
{ Epidermis with distinct pores; antheridia in a median furrow of the thallus *III. Ricciocarpus*

II. RICCIA L.

Riccia Mich., Nov. Pl. Gen. p. 107 (1729).
Riccia L., Sp. Pl. p. 1138 (1753).

Monoicous and dioicous. Thallus dichotomously branched, usually *forming rosettes on damp earth*, with linear to cordate segments,

or more *rarely floating in water* when in the sterile state and later attached to the mud and then fertile. Dorsal surface bluish-green, generally with a distinct *median furrow*; margins occasionally with cilia. Chlorophyll-bearing layer with narrow enclosed air-spaces, or with large chambers which often break through the dorsal surface, giving the thallus a lacunose appearance. Ventral scales originally in one row, but later, through rupturing in the median line, apparently two-rowed. Antheridia and archegonia *irregularly mixed* in monoicous species. *Capsule immersed.* Spores large, tetrahedral, convex on the outer face, the inner faces plane, the surface usually marked with ridges forming areolae, with papillae frequently on the angles.

The genus *Riccia* is composed of small plants which nearly always form more or less complete rosettes on soil. Upwards of 140 species have been described, the majority being inhabitants of the Southern Hemisphere. Few species are found in Northern Europe. It is a difficult genus for the student, considerable experience being necessary for the determination of the species. Living plants should always be examined when possible; in default of these, the specimen must be soaked in hot water for some time until it recovers its normal form. Transverse sections of the thallus must always be made in order to identify the species. The section varies according to the part of the thallus at which it is made. When only one section is mentioned in the description it is supposed to be taken from about the middle of the terminal segment. In making a section care must be taken not to destroy the margins, also that it be not taken at the bifurcation of the segments.

The dorsal epidermis in nearly all our species is composed of a single layer of cells, these cells being either more or less rotundate or inversely pyriform, that is, the upper part being prolonged into a beak-like protuberance (mamillate). The lateral parts of the ventral surface of the thallus are named the sides. The ventral scales are in most species destroyed on the older parts and are to be seen only near the apex of the segments. All our species may have some tinge of violet on the underside, especially when on dry and sunny positions, but in some species this colouring rarely occurs. Some species are apparently never furnished with cilia, but in several we have both naked and ciliate forms. The cilia in general increase or decrease in amount according to the respective dryness or wetness of the season and the exposure to light or shade, also in some species to the state of maturity of the plant; but the biological significence of the cilia or of the violet colouring in *Riccia* is not known definitely. The inflorescence is sometimes difficult to determine, as antheridia and archegonia may not always be present at the same time in monoicous species; many sections may have to be made, or the plant kept under observation for some time before the inflorescence can be made out with certainty. As the archegonium in its development becomes flask-shaped, with its neck formed into a canal which is expanded at the apex, it has a very different appearance from that of the antheridium, and can be readily distinguished from it. The size of the spores is frequently a character of importance, as also may be the number and size of the areolae on the convex face. It is sometimes difficult to distinguish the areolae; in such a case Warnstorf recommends a concentrated solution of chloral hydrate as a clearing agent.

Most of our species are to be found from Autumn to Spring and are then in fruit, but some are also to be seen in Summer. Antheridia are generally to be found in early Autumn some weeks before the spores are mature; later in the season they may be found only near the apex of the thallus or may have disappeared.

1 { Thallus with conspicuous air-cavities 2
  Thallus without conspicuous air cavities 4

2 { Commonly floating; dorsal surface of thallus never lacunose... *14. fluitans*
  Not floating; dorsal surface of the older parts of thallus lacunose..... 3

3 { Green (finally yellowish); segments 2–2·5 mm broad..... *12. crystallina*
  Tinged with purple; segments to 1 mm broad ..... *13. pseudo-Frostii*

4 { Margin of thallus ciliate 5
  Margin of thallus naked 9

5 { Cilia mostly ·250–1 mm long, numerous, persistent 6
  Cilia mostly less than ·250 mm long, usually few 7

6 { Cross-section twice or more as broad as high, cilia to 1 mm long ... *3. ciliata*
  Cross-section less than twice as broad as high, cilia to ·440 mm long *4. Crozalsii*

7 { Cross-section about 1·5 times as broad as high..... *8. Warnstorfii*
  Cross-section 2·5–3 times as broad as high (cf. *R. glauca*) 8

8 { Monoicous; spores 95–120 μ ..... *6. Lescuriana*
  Dioicous; spores 90–100 μ ..... *5. Michelii*

9 { Underside of thallus more or less purple 10
  Underside of thallus green 13

10 { Underside with closely imbricated semi-lunar scales ..... *11. nigrella*
  Underside without closely imbricated semi-lunar scales..... 11

11 { Cross-section about 1·5 times as broad as high..... *8. Warnstorfii*
  Cross-section more than twice as broad as high 12

12 { Spores 75–90 μ ..... *7. bifurca*
  Spores 95–120 μ ..... *6. Lescuriana*

13 { Cross-section 4–5 times as broad as high, broadly channelled above; epidermal cells without thickened walls ..... *9. glauca*
  Cross-section 2–3 times as broad as high, sharply furrowed above; epidermal cells with thickened walls ..... *10. sorocarpa*

Subgen. **Euriccia** (Lindb.) Boulay

Riccia B. *Euriccia* a. *Terrestres* et b. *Spongides* Lindb., Musc. Scand. p. 2 (1879).

Riccia Sect. I. *Euriccia* Schiffn. (excl. *R. crystallina*), in Engl. and Prantl I 3, p. 14 (1893).

Riccia A. Steph., Spec. Hep. I p. 6 (1898).

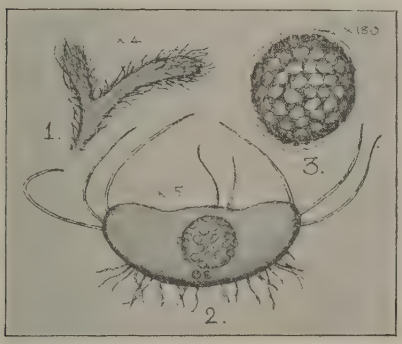
Riccia Subgen. *Euriccia* Boulay, Musc. de la France II p. clxv (1904).

Chlorophyll-bearing layer consisting of narrow, erect columns composed of one layer of cells, each four of which columns enclose a

narrow air-space which is covered over by the dorsal epidermis. Spores with their exit through the dorsal surface of the thallus.

3. Riccia ciliata Hoffm.

Riccia ciliata Hoffm., Deutsch. Fl. II p. 95 (1795).



1. Plant. 2. Cross-section. 3. Spore.

Monoicous. In incomplete rosettes, *grey-green above*, concolorous beneath or with margins tinged with purple-black. Thallus 3–7 mm long and 1–1·5 mm broad, 1–2 times dichotomously branched, segments *linear-cuneate, nearly flat* except at the narrowly channelled apex, the margin rounded *with numerous long, straight or curved, persistent bristle-like cilia to 1 mm long* in one or more rows. Ventral scales colourless or tinged with violet. Cross-section 2·5–3 times as broad as high, the dorsal surface *slightly concave*, the ventral surface *broadly semicircular* with the sides ascending to the thick but not elevated margin, making the section semilunar. Epidermal cells thin-walled, not mamillate. Spores 70–90 μ in diam., black, the margin narrow, crenulate; outer face with 9–11 areolae across the diam., bluntly papillose in profile.

Hab. On banks and in stubble fields.

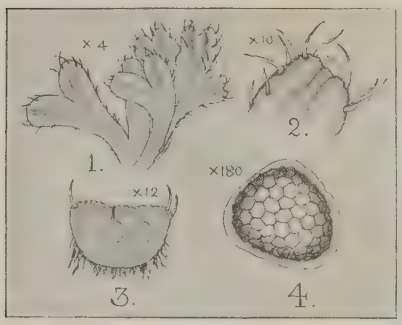
Distrib. Quarry field near Penzance, Cornwall (*W. Curnow*). Near Tavistock, Devon (*J. Ralfs* and *W. Curnow*)?

The numerous persistent, long, bristle-like cilia distinguish this from our other species except *R. Crozalsii*. It has a greyish-green appearance, and the ventral side is most commonly green. It has apparently only once, or at most twice, been found in Britain. I have only seen a micro-slide of the British plant, insufficient to form an opinion, but Pearson has had the opportunity of examining a specimen and considers it to be this species.

A closely related Continental species is *R. intumescens* (Bisch.), which differs in having a broad channel on the dorsal surface of the thallus and a swollen, elevated margin.

4. Riccia Crozalsii Levier

Riccia Crozalsii Levier, Revue Bryol. p. 73 (1902); K. Müll., Rabh. Krypt. Fl. Leb. p. 169 (1907); D. A. Jones, Journ. Bot. p. 104 (1909).



1. Plant. 2. Apex of a segment. 3. Cross-section. 4. Spore.

Monoicous. Minute. Seldom forming complete rosettes, pale or glaucous-green above, concolorous or *more or less purple beneath.* Thallus 2-3·5 mm long and ·5–·75 mm broad, furcate or single, the segments divergent, at first linear, later oval or linear-obovate, thick, sharply furrowed at the apex and broadly channelled at the middle of the segment, the margin elevated and swollen, *with sharp cilia 220–400 μ long*, mostly in two rows, those of the inner row often inflexed, most numerous towards the apex of the segment and sometimes absent elsewhere, but frequently extending along the whole length of the thallus. Ventral scales small, hyaline or purple. Cross-section at apex of terminal segment almost as high as broad, *at middle of segment one half broader than high* with the dorsal surface broadly channelled and the *ventral surface semi-circular*, the sides *ascending steeply* to the obtuse or somewhat acute margin. Epidermal cells thin-walled, not mamillate. Spores *65–80 μ*, black, margin narrow, finely granulate; outer face with 8–11 areolae across the diam., coarsely papillose in profile. Antheridial osteoles near the apex of the segments, little prominent.

Hab. On banks and ledges of rock and on mud-covered walls.

Distrib. Wales, uncommon.

The Welsh plant shows in different localities the two forms mentioned by Schiffner in *Oest. Bot. Zeit.* No 8, 1905, as seen by him in French and Italian specimens, viz. the small typical plant forming almost complete rosettes and more or less violet beneath, and a larger form, probably of shady ground, more tumid, less violet beneath, cilia longer, and the plant not forming rosettes.

R. Michelii is dioicous, almost twice as large, more furcate, cilia shorter, cross-section 2–3 times as broad as high, spores 90–100 μ.

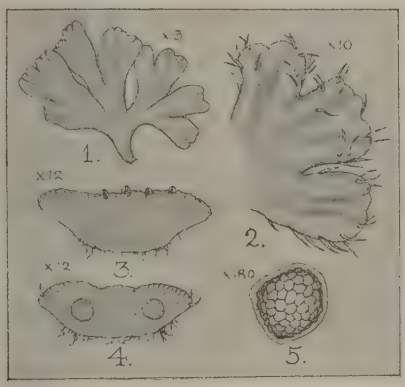
R. ciliata is larger, cross-section 2–3 times as broad as high and semilunar, the dorsal surface nearly flat, cilia much longer, spores 80–90 μ.

R. Lescuriana can be distinguished at once by its large spores, 95–120 μ;

it is also usually a larger plant, the cross-section is quite different, and cilia when present are shorter.

5. Riccia Michelii Raddi

Riccia Michelii Raddi, Op. Scient. Bologna p. 352 (1818).
R. tumida Lindenb., Syn. Hep. Eur. p. 120 (1829).
R. tumida Lindenb. *β. linearis* Nees, Eur. Leb. IV p. 407 (1838).
R. palmata Lindenb., Monog. d. Riccieen p. 457 (1836).



1. Plant. 2. Segments showing cilia.
3. Cross-section of male. 4. Do. of female.
5. Spore (unusually small).

Dioicous. In rosettes or somewhat extended patches, glaucous-green above, *more or less violet* or concolorous beneath. Thallus 5–10 mm long and 2 mm broad, 2–4 times dichotomously branched, the segments *oblong-obovate or linear with rotundate or obcordate apex*, the dorsal surface broadly channelled, *the margin raised and swollen, usually with short cilia.* Ventral scales colourless or violet. Cross-section 2·5–3 times as broad as high, the dorsal surface with a broad, flat channel, the ventral surface rather strongly arched and semi-circular below with the sides ascending somewhat suddenly to the elevated, swollen margin. Epidermal cells thin-walled, not mamillate. Capsules deeply immersed, styles not prominent. Spores *90–100* μ in diam., fuscous, margin narrow, unequal; outer face with 8–10 areolae across the diam., 5–7 μ wide, papillose in profile. *Antheridial osteoles numerous* in two rows, colourless or violet, *greatly prominent.*

Hab. On banks, mud-covered walls and on rocky soil.

Distrib. S. of England *(W. E. Nicholson).*

In the older part of the thallus, the section is 3–5 times as broad as high, the dorsal surface nearly flat and the ventral surface weakly curved.

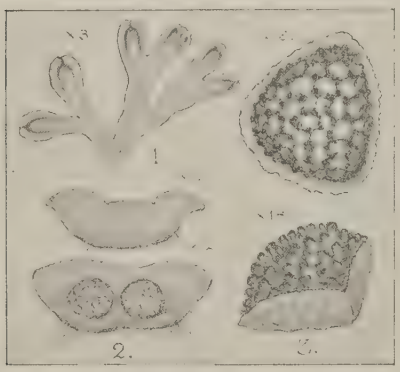
The dioicous inflorescence will separate *R. Michelii* from our other species. When without inflorescence it is difficult to separate from *R. Lescuriana* and *R. bifurca*. The monoicous inflorescence of the former can generally be detected and the spores and areolae are larger. The latter is a smaller plant with the older parts characteristically orange-red, the section of the thallus more rectangular, and cilia are rarely present; the spores also differ in size.

R. Crozalsii is a smaller plant with much longer cilia and a different section as well as smaller spores.

R. glauca var. *subinermis* has the terminal segment of the thallus 4–5 times as broad as high with the sides ascending very obliquely to the thin margin.

6. Riccia Lescuriana Aust.

Riccia Lescuriana Aust., Proc. Acad. Nat. Sc. Phil. p. 232 (1869).
R. glaucescens Carr. in Carr. and Pears., Hep. Brit. Exs. No. 66 (1878).



1. Plant. 2. Cross-sections near apex and near middle of segment. 3. Spores.

Monoicous. Usually in incomplete rosettes, glaucous-green above, *more or less purple beneath*. Thallus 5–10 mm long and 2–3 mm broad, 2–3 times dichotomously branched, segments elongate, *linear-cuneate* to linear-obovate, with a broad flat channel and *thick, raised and slightly convex margin*, the apex rounded or emarginate; the margin most frequently naked, sometimes with a few, short cilia, rarely with cilia in one or two distinct rows. Ventral scales violet or colourless, inconspicuous. Cross-section 2·5–3·5 times as broad as high, shallowly channelled above, *broadly convex below*, the sides *gradually* ascending to the *rather thick and slightly recurved margin*. Epidermal cells *pyriform* and rotundate, thin-walled. Spores *95–120* μ in diam., dark reddish-brown, margin entire, finely granulate; outer face with *7–9 areolae* across the diam., *to 15* μ *wide*, highly papillose in profile. Antheridial osteoles prominent.

Hab. On soil among rocks and on banks.

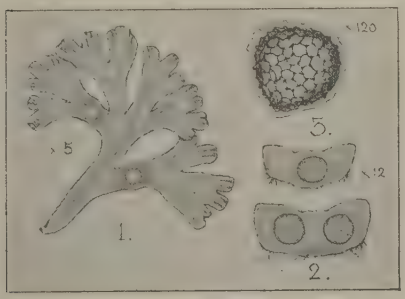
Distrib. N. to Forfar, uncommon.

To the notes given under the other species may be added the usually elongate segments, linear-cuneate to linear-obovate, mostly tinged with purple beneath. The spores are larger than those of the others as are also the areolae. The plant with somewhat numerous cilia is rare in this country and is difficult to distinguish from *R. Michelii*. The latter is a dioicous species and has smaller spores and areolae. *R. bifurca* has a more rectangular section and smaller spores. Some of the published figures of sections of *R. Lescuriana* have evidently not been taken from living material. In the living plant the flanks i.e. the

parts of the dorsal surface between the median furrow and the margin are convex, and the margin almost subacute in section down to the middle of the thallus; from this point backwards the margin is thick. Carrington's *R. glaucescens* is without doubt monoicous. Specimens from the original locality, collected by Pearson and others, show this.

7. Riccia bifurca Hoffm.

Riccia bifurca Hoffm., Deutsch. Fl. II p. 95 (1795).
R. bifurca Lindenb., Monog. d. Riccieen p. 429 *pl.* 20 fig. 1 (1836).



1. Plant. 2. Cross-sections. 3. Spore.

Monoicous. Usually in rosettes 7–15 mm in diam., glaucous-green above and *in the older parts orange-red, tinged with violet* or concolorous beneath. Thallus 3–7 mm long and 1–2 mm broad, 1–2 times dichotomously branched, the terminal segments ovate to oval and narrowed at the apex, or narrowly oblong, *with a broad, flat channel and thick ascending margins.* Ventral scales usually violet. Cross-section 2–4 times as broad as high, semilunar at the apex of the terminal segment and *nearly rectangular at the middle*, the *margin thick and swollen.* Epidermal cells rotundate, not mamillate, thin-walled. Spores *75–90* μ in diam., reddish-brown, margin irregularly crenate; outer face with *6–8* areolae across the diam., 6–7 μ wide, bluntly papillose in profile. Antheridial osteoles conspicuous near the apex of the thallus.

var. **subinermis** Heeg, Bot. Notis. p. 111 (1898).

Margin of terminal segment with a few acutely pointed cilia.

Hab. On moist soil among rocks, on banks and in stubble fields.

Distrib. N. to Perthshire, rare.

Is often difficult to distinguish from small forms of *R. Lescuriana*. The section of *R. bifurca* is nearly rectangular, the sides passing abruptly up to the margin which is almost always without cilia, while in *R. Lescuriana* the lower surface is broadly convex with the sides passing rather gradually upwards, and cilia are frequently present. The spores are much smaller in *R. bifurca*, and the areolae on the outer face only about half the size.

The orange-red colour of the older parts of the thallus is a useful distinguishing character of this species.

The cilia in the var. *subinermis* are always few in number, and may be absent in adjoining plants, or even in the same plant under different conditions, as in some of the other species; but this is by no means always so, and the presence or absence of cilia cannot be considered as merely owing to the surrounding conditions.

8. Riccia Warnstorfii Limpr. in Warnstf.

Riccia Warnstorfii Limpr. m.s. in Warnstf., Verh. Bot. Ver. Jahrg. 27 p. 85 (1885); Steph., Spec. Hep. I p. 10 (1898); K. Müll., Rabh. Krypt. Fl. Leb. p. 189 (1907); Nicholson in Hast. and East Suss. Nat. I 6 p. 258 (1911).

1. Plant. 2. Cross-section. 3. Do., var. *subinermis*. 4. Spore.

Monoicous. *Small.* In usually complete rosettes 6–13 mm in diam., *yellow-green* or green, more or less violet-coloured beneath. Thallus to 5 mm long and 1 mm broad, *regularly 2–3 times divided, thick, the segments linear*, rounded or truncate at the apex, *rather broadly channelled* towards the ultimate segments, the channels disappearing in the main divisions, *the margin thick* but usually shortly acute, sometimes swollen and elevated. Cross-section about 1·5 times as broad as high, strongly convex below, the sides passing *steeply* to the slightly recurved and *thick* margin, the upper surface rather broadly channelled then slightly convex to the margin. Epidermal cells thin-walled, rounded, with a few pyriform and mamillate. Ventral scales *frequently violet*. Spores 67–84 μ in diam., nearly black, with a broad, pale brown, nearly entire border, areolae 6–8 across the face, coarsely papillose in profile.

var. subinermis Warnstf., Krypt. Fl. Mark Brand. p. 73 (1902).

Riccia Warnstorfii var. *ciliaris* Warnstf. Verh. Bot. Ver. Brand. Jahrg. 41 p. 22 (1899).

Margin of thallus with a few or several cilia.

Hab. In stubble fields and other cultivated land.

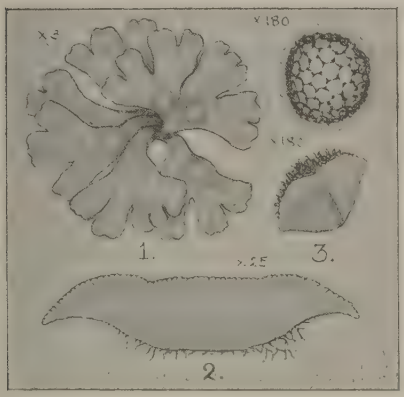
Distrib. S. of England *(W. E. Nicholson)*.

This is smaller than our other species. The repeatedly divided linear segments, the thick thallus frequently violet beneath and rather commonly having some cilia on the margin, allow this plant to be generally recognised. The section is sometimes almost quadrate and the margins raised and swollen.

The size of the spores is variously given by authors. I find them to average about 77 μ on the few British specimens which I have seen.

9. Riccia glauca L.

Riccia glauca L., Sp. Pl. p. 1139 (1753).
R. glauca Lindenb., Monog. d. Riccieen p. 417 *pl.* 19 (1836).



1. Plant. 2. Cross-section. 3. Spores.

Monoicous. Usually in rosettes, 12–15 mm in diam., green or glaucous-green above, concolorous beneath, paler when dry. Thallus 5–8 mm long and 1–3 mm broad, 2–3 times dichotomously branched, *segments thin*, obovate to cuneate, with a *broad, flat channel disappearing in the main divisions*, the apex emarginate or truncate. Ventral scales nearly always colourless, evanescent. Cross-section *4–5 times as broad as high*, the dorsal surface with a *broad channel*, the ventral surface *weakly arched*, the sides passing *very obliquely* to the *thin and sharp* margin. Epidermal cells of one layer, rotundate and pyriform, thin-walled. Spores 75–90 μ in diam., dark brown, the margin broad, to 7 μ, yellowish-brown, granular-papillose; outer face with *7–8* areolae across the diam., 7–11 μ wide, coarsely papillose in profile.

var. **major** Lindenb., loc. cit. p. 418 *pl.* 19 fig. 12–13.

In larger rosettes, 15–22 mm in diam.; main divisions of thallus obcordate, the segments less deeply divided, terminal segments slightly channelled.

var. **minor** Lindenb., loc. cit. p. 418 *pl.* 19 fig. 14–16

Rosettes much smaller, to 8 mm in diam., green, thallus 3–5 mm

long and ·7–1 mm broad, the segments deeply divided, terminal segments linear-cuneate to oblong, the apex rounded or shortly emarginate; spores as in the type, but sometimes paler brown and with rather larger areolae.

var. **subinermis** (Lindb.) Warnst., Krypt. Fl. d. Mark Brand. p. 70 (1902).

Riccia subinermis Lindb., Med. Soc. F. et Fl. Fenn. (1881).

Margin of thallus with a few, short, sharply pointed cilia; thallus generally smaller and more yellow in colour than the type.

Hab. In moist retentive soil in cultivated ground and on banks.

Distrib. N. to Perth, frequent; Ireland.

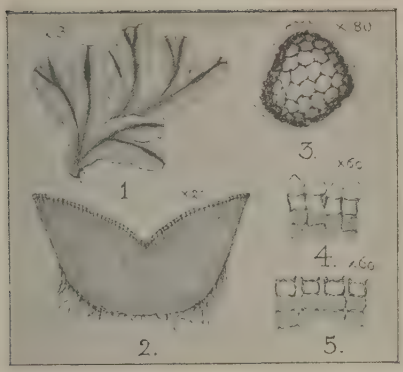
The thallus being 4–5 times as broad as high, nearly always green on both surfaces, and the sides passing very obliquely to the thin and acute margin, render this species easily known. It has been much confused with our other common species, *R. sorocarpa*, but there is not much resemblance between them. In the field they can generally be distinguished with a pocket lens by observing them from an end view, *R. glauca* having a nearly flat thallus with the upper and lower surfaces nearly parallel, while the other is boat-shaped; in the former also the channel on the upper surface does not extend to any distance backwards, the older parts appearing convex above; on the other hand, in *R. sorocarpa* the channel continues into the older parts. Under the microscope the plants cannot be confused, the dorsal epidermis and the section being quite different. The smaller spores will alone distinguish *R. glauca* from any form of *R. Lescuriana*, with which it is sometimes confused.

Intermediate forms between the var. *major* and the type occur, also probably between the type and var. *minor*, but the latter is found in the Highlands of Scotland almost to the exclusion of the typical plant. The var. *subinermis* has only as yet been found in small quantity in the south of England.

10. Riccia sorocarpa Bisch.

Riccia minima L. p.p., Sp. Pl. p. 1139 (1753).
R. sorocarpa Bisch., Act. Acad. Nat. Cur. XVII p. 1053 *pl.* 71 fig. 11 (1835).
R. minima Lindenb., Monog. d. Riccieen p. 427 *pl.* 20 p.p. (1836).
R. Raddiana Jack m.s., Steph., Spec. Hep. I p. 28 (1898).

Monoicous. Usually in rosettes, 8–12 mm in diam., *glaucous-green* and somewhat crystalline above, concolorous beneath, grey-green and narrowed when dry, *the margin being then erect* and slightly incurved. Thallus 4–9 mm long and 1–1·5 mm broad, 2–3 times dichotomously branched, the segments oblong-ovate, *narrowed to the subacute apex*, with a *deep, narrow furrow*. Ventral scales colourless, distinct near the apex and frequently reaching to the margin.



1. Plant. 2. Cross-section. 3. Spore. 4. Portion of section with epidermal cells intact. 5. Do. in later stage.

Cross-section *2–3 times as broad as high*, the dorsal surface with a *narrow furrow*, the ventral surface strongly convex, *the sides passing abruptly to the sharp margin. Epidermal cells of two layers*, the upper mamillate and soon destroyed, *the lower cubic with thick walls.* Spores *65–80* μ in diam., dark brown, the margin narrow, yellowish-brown, irregularly crenulate and shortly papillose; outer face with *8–10* areolae across the diam., 6–9 μ wide, highly papillose in profile.

Hab. On moist retentive soil in cultivated ground and on banks.

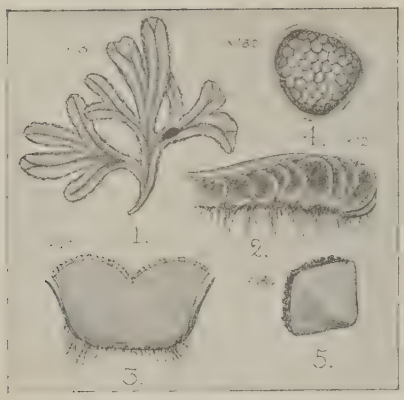
Distrib. N. to Elgin, rather common; Ireland.

Easily identified from our other concolorous species by the thick-walled epidermal cells. The upper layer of epidermal cells are early destroyed, but may frequently be seen for some time at the median furrow. On the disappearance of the cells of the upper layer those of the lower layer become thickened and act as the epidermis. The thickened cell-walls can be seen near the margin of the thallus without making sections. The ventral scales are noticeable towards the end of the segments and reach to the margin; rarely they are tinged with violet. In a section of the thallus the narrow furrow is readily seen and the sides abruptly ascending to the acute margin.

11. Riccia nigrella DC.

Riccia minima L. p.p., Sp. Pl. p. 1138 (1753).
R. nigrella DC., Flor. Franc. 5 p. 193 (1815).
R. minima Raddi, Op. Scient. Bologna p. 353 (1818).
R. Pearsoni Steph., Spec. Hep. I p. 27 (1898).

Monoicous. Small. Usually in incomplete rosettes, *dark green* and somewhat glaucescent above, the older parts occasionally orange-red, *dark purple and shining beneath.* Thallus 3·5–4·5 mm, more rarely to 6 mm long, and ·75–1 mm broad, 1–3 times dichotomously branched, *the segments widely divergent from an acute angle, linear, sharply channelled*, the margin acute, *strongly involute when dry*, the terminal segments linear-obovate to shortly lanceolate, rounded



1. Plant 2. Segment, lateral view, showing ventral scales. 3. Cross-section. 4, 5. Spores.

or subacute at the apex. *Ventral scales large, semilunar, imbricated, dark purple*, extending to but not beyond the margin. Cross-section *1·5–2* times as broad as high, nearly subquadrate, the dorsal surface *deeply and sharply channelled*, the ventral surface weakly arched in the middle and rising *almost vertically* to the acute and slightly recurved margin. Epidermal cells thin-walled, not mamillate. Spores 58–75 μ in diam., nearly black, the margin broad and nearly entire; outer face averaging 8 areolae across the diam., almost smooth in profile. Antheridial osteoles little or not prominent.

Hab. On mud-covered walls and on banks.

Distrib. Wales, rare.

The dark green narrow segments with their sharp furrow, and the large purple semilunar ventral scales, render this plant easily distinguished. Our plant is undoubtedly monoicous, but the antheridial osteoles are difficult to find when the sporogones are in evidence, and this probably accounts in great measure for the confusion regarding the inflorescence. I agree with Mr. Pearson in considering the British plant identical with the Continental *R. nigrella* D.C; I cannot find any difference between the sections or other characters of the two plants.

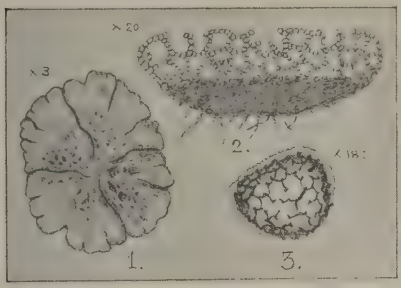
Subgen. **Ricciella** (Braun) Boulay

Ricciella Gen. Braun in Bot. Zeit. p. 756 (1821); Warnst., Krypt. Fl. Mark Brand. p. 67 (1902).
Riccia Sect. 2. *Ricciella* Bisch., Bemerk. March. u. Ricc. p. 160 reprint (1835).
Riccia B. *Ricciella* Steph., Spec. Hep. I p. 36 (1898).
Riccia Subgen. *Ricciella* Boulay, Musc. de la France II p. clxiv (1904).

Chlorophyll-bearing layer consisting of variously directed walls composed of one layer of cells, enclosing large air-chambers which usually break through the dorsal epidermis. Spores mostly with their exit through the ventral surface of the thallus.

12. Riccia crystallina L.

Riccia crystallina L., Sp. Pl. p. 1138 (1753).



1. Plant. 2. Cross-section. 3. Spore.

Monoicous. In rosettes, 10–22 mm in diam., grey-green, *frequently yellowish, when young crystalline*, concolorous beneath. Thallus 5–10 mm long, *thick, obcuneate*, several times dichotomously branched, the segments crowded, *becoming spongy in appearance* through disorganisation of the dorsal epidermis, terminal segments 2–2·5 mm broad, *obcuneate to obcordate*. Cross-section 2–3 times as broad as high, *almost rectangular*, the dorsal and ventral surfaces being nearly flat and parallel, the margin obtuse; *air-chambers large*. Ventral scales absent or obsolete. Spores *65–80* μ in diam., dark brown, margin narrow, granular-papillose; outer face with 6–8 areolae across the diam., some being frequently incomplete, shortly papillose in profile.

var. **angustior** Nees, Eur. Leb. IV. p. 430 (1838); Warnstf., Krypt. Fl. d. Mark Brand. p. 81, and *fig.* 6c p. 79 (1902).

Plants in somewhat extended and frequently compact patches. Thallus *narrower*, 1–2 mm broad, *linear*, usually slightly broader at the end and emarginate or rounded, but not obcordate.

Hab. On mud at the side of ponds and in wet ground in fields. Var. *angustior* on damp sand on the sea-shore.

Distrib. N. to Fife, uncommon.

The only plant with which this might be confused is *R. pseudo-Frostii*. The broad flat spongy thallus of the present plant with its obcordate segments which are not tinged with violet, and the large spores, are unlike even the largest forms of that species.

The older British botanists confused the present plant with *R. glauca;* the latter can be at once distinguished by the absence of cavities in the epidermis and of the large air-chambers seen on section.

The spongy appearance is caused by the greater expansion of the older parts of the thallus with the air-chambers, while there is no corresponding growth of the epidermal cells, the epidermis thus ruptures and the cavities are left open above.

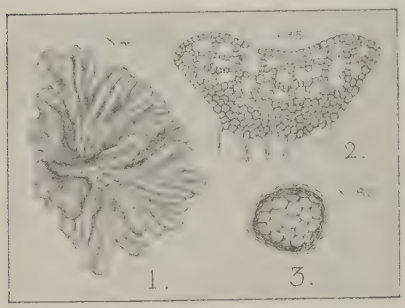
In *R. crystallina* the spores break through the dorsal epidermis; in *R. fluitans* and *R. pseudo-Frostii* they break through the ventral surface.

The var. *angustior* is very different in appearance from the type in its crowded and overlapping fronds which are nearly linear; it resembles the typical plant in its colour and other characters and is connected with it through intermediate forms.

13. Riccia pseudo-Frostii Schiffn.

Riccia Huebeneriana Lindenb. var. *pseudo-Frostii* Schiffn., Oest, Bot. Zeit. p. 2 (1905).

R. pseudo-Frostii Schiffn., Oest. Bot. Zeit. (1907); K. Müll., Rabh. Krypt. Fl. p. 207 (1907); Nicholson in Hast. and East Suss. Nat. I. 6 p. 260 (1911).



1. Plant. 2. Cross-section. 3. Spore.

Monoicous. In crowded, complete or incomplete rosettes, 5-10 mm in diam., green or yellow-green, *usually tinged with vinous-red*, sometimes wholly violet, concolorous beneath. Thallus 3–5 mm long and 1 mm broad, 1–3 times dichotomously branched, the *segments parallel or slightly divergent*, frequently over-lapping, *becoming pitted* through the disorganisation of the epidermis. Segments *linear*, nearly flat above, the terminal one channelled, apex rounded and emarginate. Cross-section about twice as broad as high, the dorsal surface with a narrow, shallow channel near the apex, the ventral surface convex, the sides obliquely ascending to the rather obtuse margin. Air-chambers large. Ventral scales rather large. Spores *56–64* μ in diam., brownish-yellow, translucent, margin broad, irregularly crenate; outer face with *6–8* areolae across the diam., *7–9* μ wide, occasionally incomplete, bluntly papillose in profile. Antheridial osteoles violet, occasionally prominent.

Hab. On mud at the sides of ponds on withdrawal of the water.

Distrib. S. of England, rare.

Some forms of this species are not unlike the land form of *R. fluitans*, which has occasionally a violet tinge on the thallus. The latter is a larger plant, more distinctly channelled, the section is obliquely semilunar, the spores much larger, the areolae only 4–5 across the face of the spore and very large; the older plants

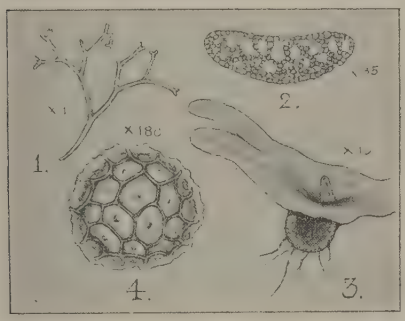
of *R. pseudo-Frostii* have a pitted appearance which nearly always will separate it. This plant is very closely allied to *R. Huebeneriana Lindenb.* I cannot find the difference in the size of spores which K. Müller gives (Rabh. Krypt. Fl. p. 208. 1907), but in the latter plant the segments are divaricate, the plant usually smaller and not in crowded overlapping rosettes, and the section rather different.

There are two forms of this species, the English plant being the smaller form: the larger has rosettes 1–3 cm in diam., the segments always parallel, and not often slightly divergent as in the case of our plant.

The North American species *R. Frostii* Aust., which has also been found in a few places on the Continent, has a similar habit to the present plant, but the sculpture of the spores is different, the ridges being more or less branched, but never formed into areolae.

√14. Riccia fluitans L.

Riccia fluitans L., Sp. Pl. p. 1139 (1753).
R. canaliculata Hoffm., Deutsch. Fl. p. 96 (1795).
Ricciella fluitans A. Braun, Allg. Bot. Zeit. p. 757 (1821).



1. Plant. 2. Cross-section. 3. Fertile segment. 4. Spore.

Monoicous. In thin sterile patches, *floating in stagnant water*, or in frequently fertile layers on mud, green or yellow-green. Thallus 10–50 mm long and ·5–1 mm broad, *several times dichotomously branched*, the segments *divergent, linear*. In the floating form very thin and nearly flat, narrowly channelled towards the apex, green on both surfaces, without rhizoids or ventral scales. In the terrestrial form, thick, broadly channelled, occasionally tinged with violet on the sides and margin, rhizoids numerous, ventral scales small, confined to near the apex of the lobes, colourless or violet; cross-section *unsymmetrically semilunar*, the margin obtuse, air-chambers large, communicating with the dorsal surface by small openings, but which later frequently become closed through swelling of the surrounding cells. Capsule forming a *spherical protuberance on the ventral side* of the thallus, furnished with rhizoids on the enclosing tissue. Spores *75–90* μ in diam., brownish-yellow, translucent, margin broad, 4–7 μ across, entire or nearly so; outer face with *4–5* areolae across the diam., *those in the centre large, 21–24* μ wide; inner faces with irregular ridges which seldom form areolae. Antheridial osteoles prominent.

Hab. Floating on the surface of the water in ponds and reservoirs, or rooting in the mud at the sides or bottom.

Distrib. N. to Perth, uncommon; Ireland.

The floating form cannot be mistaken for any other of our hepatics. It has more resemblance to some states of *Callitriche hamulata*. The terrestrial plant might be occasionally confused with some states of *R. pseudo-Frostii*, under which species distinguishing characters have been given.

Adventive branches from the ventral side of the thallus are common in the floating form. These become detached and form new plants. In this form the dorsal epidermis forms a complete covering over the air-chambers, but in the terrestrial form this covering remains incomplete, the air-chambers thus communicating with the dorsal surface by means of small openings, which however are not true pores such as occur in *Ricciocarpus* and in the *Marchantiaceae*. The terrestrial form is frequently classed as a variety, or is considered as the type of the species. In Scotland the only form met with is the terrestrial plant, where it is always submerged except in dry seasons, growing on the mud at the bottom, while in parts at least of England it only occurs as a stranded plant on the margins on withdrawal of the water on which it had been floating.

III. RICCIOCARPUS Corda

Ricciocarpus Corda in Opiz, Beitr. p. 651 (1829).

Thallus dichotomously branched with obcordate lobes, *floating in the water* and later fruiting on the mud, seldom forming rosettes. Chlorophyll-free layer very weakly developed, the thallus consisting for the greater part of polyhedral air-chambers, the walls of these, as well as the dorsal epidermis, *with distinct pores;* ventral surface with *long, dentate, violet-coloured scales*. Archegonium *surrounded by a rudimentary involucre*. Capsule *immersed*. Antheridia situated *in a toothed ridge in a median furrow* of the thallus.

Ricciocarpus differs from *Riccia* in the archegonia being surrounded by a rudimentary involucre, the antheridia situated in a furrow along the centre of the thallus, the presence of distinct pores, i.e., pores surrounded by special cells, the ventral scales originally in several transverse rows, the presence of oil-bodies as in the *Marchantiaceae*, and in the great development of the chlorophyll-bearing tissue.

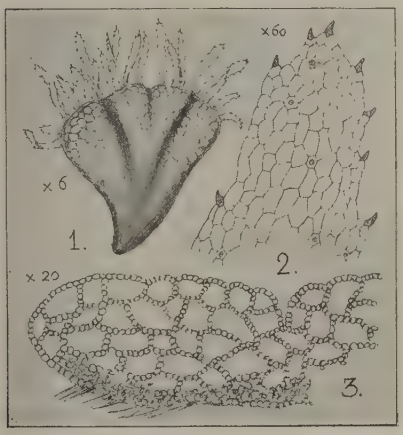
Some authors consider that *Ricciocarpus* is not entitled to generic rank, and have replaced *R. natans* in the genus *Riccia*.

This genus has until recently contained only the widely distributed *R. natans*, but Stephani in *Species Hepaticarum* has included another species, *R. velutinus* from western America.

Ricciaceae comprises a third European genus in *Tessellina* with a solitary species, *T. pyramidata*, which is found in the southern parts of the Continent. This genus occupies an intermediate position between *Ricciaceae* and *Marchantiaceae*, having the sporophyte of the former and the thallus of the latter.

15. Ricciocarpus natans (L.) Corda

Riccia natans L., Syst. Veget. p. 956 (1781).
Ricciocarpus natans Corda in Opiz, Beitr. p. 651 (1829).



1. Plant, floating form. 2. Apex of ventral scale. 3. Cross-section of thallus.

Dioicous? Thallus 5–10 mm long and 4–8 mm broad, 2–3 times dichotomously branched. *Lobes obcordate with a distinct median furrow throughout*, divided near the apex of the lobes. Air-chambers large with unistratose walls, *showing through the dorsal epidermis as hexagonal areolae*, in each of which is a minute pore surrounded by 6–8 cells with slightly thickened walls. Cross-section nearly flat, becoming thinner towards the obtuse margin, slightly convex on the ventral surface, and on each side of the furrow on the dorsal surface. Floating form resembling *Lemna*, green or more or less violet, with *long*, *pendent*, *serrated*, *violet scales on the ventral surface*, and with few rhizoids or none. Terrestrial form in crowded imperfect rosettes, yellow-green, frequently tinged with dark red, with greatly reduced colourless or violet-coloured ventral scales and rather numerous colourless smooth rhizoids. Capsule single or in pairs in rows in the centre of the thallus. Spores 51 μ (Stephani), dark brown with areolae becoming imperfect, escaping through a slit along the median furrow of the thallus.

Hab. Floating in stagnant water, or on mud at the margins.

Distrib. From York southd., rare; Ireland.

This plant can hardly be confused with any other species. The dorsal surface does not become pitted as in *R. crystallina*. I have not seen capsules, which are very rare everywhere, on the British plant.

One of the modes of increase in this species, is by the thallus splitting along the median line, the halves separating and forming new plants.

Goebel mentions that the ventral scales of the water form may be considered as leaves. They possess chlorophyll and thus co-operate in assimilation. They increase the surface by which water may be absorbed and also give the plant more stability. In the land form these scales are much reduced and only serve to protect the vegetative point.

Family III. MARCHANTIACEAE

Chlorophyll-bearing layer nearly always *with highly developed air-chambers*, from the floors of which arises a filamentose assimilative tissue. *Pores* (except in *Dumortiera*) *always present*. *Sexual organs always in groups, frequently on long peduncled capitate receptacles*. *Sporogonium with foot and pedicel*, the mature capsules breaking through the calyptra and *dehiscing by teeth or a lid*, rarely by 4–8 valves. *Sterile cells*, usually developed as elaters, *always present*, as well as spores.

As most of our species of this family are commonly met with in a sterile condition, it is necessary to be able to distinguish them by the thallus. Fortunately there is little difficulty in doing this. The student will soon learn to know each species by its general appearance, but failing this other characters are readily available. The pores are either simple, with one opening, or compound ("barrel-shaped"); in the latter case they are surrounded by 4–5 rings of superimposed cells, and have an upper and a lower opening. The characteristic differences in the pores of each species can be usually detected by placing a small piece of the thinner part of the thallus under the microscope. The lower layer of the barrel-shaped pores can even be frequently distinguished in this way by careful focussing. It is advisable, however, in all cases, that a thin piece of the dorsal epidermis should be sliced off with a razor, when the enclosing cells of the pores and the condition of their walls and angles can be much more clearly observed. When the pores are barrel-shaped, their lower layer can be seen by examining the underside of the piece. It is also important to note whether the angles of the cells of the dorsal epidermis are thickened or not, as well as those of the pores. Sections of the thallus can also easily be made. These show at once whether the pores are simple or barrel-shaped, as well as the structure of the various parts mentioned in the descriptions. The section in each species is

quite distinct. The ventral scales have also usually easily observed differential characters.

1 { Gemmae-receptacles present 2
  { Gemmae-receptacles absent 3

2 { Gemmae-receptacles beaker-shaped with fringed margin ; pores compound ..... *X. Marchantia*
  { Gemmae-receptacles lunulate with entire margin ; pores simple ..... *VII. Lunularia*

3 { Air-chambers and pores absent..... *VIII. Dumortiera*
  { Air-chambers and pores present..... 4

4 { Dorsal epidermal cells with thickened angles..... 5
  { Dorsal epidermal cells without thickened angles 6

5 { Pores conspicuous, air-chambers in one layer ; ♀ involucre sessile below apex of thallus..... *IV. Targionia*
  { Pores hardly visible, air-chambers in several layers ; ♀ involucre stalked ..... *V. Reboulia*

6 { Areolae large and regular, visible to the naked eye, pores simple, ventral scales rather distant ..... *VI. Conocephalum*
  { Areolae smaller, not visible to the naked eye, pores compound, ventral scales imbricate ..... *IX. Preissia*

Subfamily **Targionioideae**

Targionieae Lindb.

Sporogonium solitary, sessile on the underside of apex of thallus, surrounded by a 2-valved involucre. Elaters 2–3-spiral, frequently branched. Antheridia on the upper surface of small disciform innovations.

This subfamily comprises the genera *Targionia* and *Cyathodium*. To the latter belongs *C. cavernarum* Kunze, which Lindberg considered to be the same plant as Dickson's *Riccia spuria* from Scotland in *Pl. Crypt. Fasc.* IV p. 20. Whether this be so or not, and the matter is doubtful, there need be no hesitation in deciding that the exotic *C. cavernarum* has not been found in Scotland. Mitten states that Dickson's plant is the Malayan *Carpolipum spurium*, also that Dickson was not particular regarding the localities which he gave for his plants, and thus used "Scotland" as a refuge for any plant, the locality of which he had forgotten.

IV. TARGIONIA L.

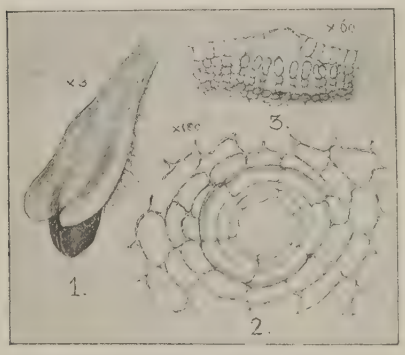
Targionia Mich., Nov. Pl. Gen. p. 3 *pl.* 3 (1729).
Targionia L., Sp. Pl. p. 1136 (1753).

Thallus coriaceous with indistinct areolae on the dorsal surface and with simple pores. *Air-chambers distinct.* Archegonia in groups immediately *behind the apex of the thallus*, only one attaining maturity. Involucre arising as a thick membrane from both sides of the group to form a sheath over the sporogonium, separated in front by a narrow vertical fissure with interlocking teeth. Pseudoperianth absent. Capsule shortly pedicellate, at length breaking through the calyptra, the *two valves of the involucre* separating, leaving a *slit-like opening;* the apical portion on dehiscence becoming detached in one or more fragments, the remainder being divided into 5–8 irregular, reflexed lobes. ♂ receptacle on small disciform apices of short innovations arising from the sides of the midrib underneath.

A small genus, of which Stephani gives only two species, almost confined to the warmer parts of the globe.

16. Targionia hypophylla L.

Targionia hypophylla L., Sp. Pl. p. 1136 (1753).
Targionia Michelii Corda in Opiz, Beitr. 1 p. 649 (1829).



1. Fertile thallus. 2. Pore from above. 3. Section through pore.

Monoicous. In small patches or extended layers of a light green colour. Thallus 10–15 mm long and 3–5 mm broad, simple or *innovating* from the *ventral side of the midrib*, more rarely dichotomously branched, slightly concave, *cuneate with incised apex.* Dorsal surface with *indistinct areolae;* epidermal cells 5–6-angled, with slightly thickened walls and *much thickened angles*, quadrate at the 1-celled margin. Pores simple, *conspicuous*, slightly

elevated, with about *4 concentric rings*, each of 6 cells, *without thickened angles*. Ventral surface strongly convex, *purple-black;* scales in one row on each side, *large*, *obliquely triangular with a broadly awl-shaped appendage*. Chlorophyll-bearing layer narrow, air-chambers distinct, the terminal cell of the filaments large and *ovoid*. Midrib prominent below, rather suddenly passing into the lamina. Involucre *subglobose*, subcompressed, *keeled*, *purple-black*. Capsule spherical, the wall of one layer of cells, with annular thickenings. Spores 65–75 μ in diam., finely reticulate and with a few ridges, the margin broad, crenulate. ♂ receptacle papillose on upper surface and with purple scales underneath.

HAB. On warm, dry rocks, especially basaltic and limestone.

DISTRIB. Devon to Skye and Perth; rare; Ireland. Fr. Feb.–April.

The purple-black involucre beneath the apex of the thallus is nearly always present, and is distinctive. In the absence of this, the large purple scales on the ventral side can be noted as different from those of the other species. It is with *Reboulia* and *Preissia* that sterile specimens are sometimes confused, but these species are easily distinguished from *Targionia* not only by the ventral scales, but by the former having the dorsal epidermis smooth when dry and with inconspicuous pores, and the latter being without the thickened angles of the epidermal cells.

The present species is a xerophyte and can withstand prolonged drought; the sides roll up laterally in dry weather, exposing only the ventral surface with its imbricated ventral scales, and thus hindering evaporation.

The spores sometimes remain immature and are smaller (50–56 μ) than the dimensions given.

The ♂ branch consists of an expanded disc seated on a cylindrical basal part. The upper surface of the disc is covered with small protuberances, the centre of each having an opening which leads to the antheridial cavity.

The ventral innovations frequently separate from the thallus and form new plants.

This species is widely distributed in warm climates; in Europe it is almost confined to the Western and Mediterranean regions.

SUBFAMILY Marchantioideae

Marchantieae Lindb.

Sporogonia aggregated on the under side of a peduncled receptacle (carpocephalum).

Marchantioideae-Operculatae

Areolæ on the dorsal surface of the thallus indistinct. Air-chambers becoming undefined through the formation of secondary walls. Apical portion of the capsule at dehiscence falling off as a cap or in fragments, the under part remaining behind as an urn-shaped cavity; capsule-wall without semi-annular thickenings. Usually only one archegonium developed in each involucre of the receptacle.

The following European genera, in addition to *Reboulia*, are included in the *Operculatae*, viz. *Plagiochasma*, *Grimaldia*, *Neesiella* and *Fimbriaria*.

V. REBOULIA Raddi

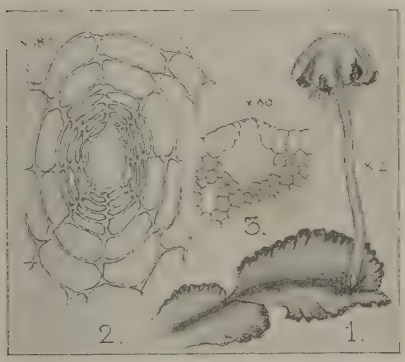
Asterella Pal. de Beauv. p.p., Encyc. Méth. Suppl. 1 p. 502 (1810).
Reboulia Raddi, Opusc. scient. di Bologna II p. 357 (1818).

Thallus dichotomously branched and innovating at the apex, coriaceous, *without distinct areolae* on the dorsal surface and with scattered *simple pores*, the originally simple air-chambers becoming divided by secondary walls, *rendering their limits indistinct*. Peduncle of ♀ receptacle arising from behind the apex of a thallus-lobe, surrounded *at base and apex by narrow scales*, with a *single root-hair furrow;* receptacle conical or hemispherical, *divided to the middle into 4–7 obtuse lobes* with air-spaces and compound pores; involucres arising from the ventral margin of the receptacle-lobes, conchoidal and 2-valved, each enclosing a single sporogonium which does not fill the cavity. *Pseudoperianth absent.* Capsule subglobose, shortly pedicellate, with a large foot, irregularly dehiscing at the apex, the lower portion being left behind as a hemispherical cup containing the spores and elaters. Elaters 2–3-spiral. ♂ *receptacle sessile*, arising from behind the apex of a thallus-lobe, oval to semicircular, surrounded with small paleae. Gemmae none.

This genus is composed of a single species which is widely spread throughout the globe, but is absent in cold climates.

17. Reboulia hemisphaerica (L.) Raddi

Marchantia hemisphaerica L., Sp. Pl. p. 1138 (1753).
Asterella hemisphaerica Pal. de Beauv., Encyc. Méth. Supp. 1 p. 502 (1810).
Reboulia hemisphaerica Raddi, Opusc. scient. di Bologna II p. 357 (1818).



1. Fertile plant. 2. Pore. 3. Section through pore.

Dioicous and monoicous. In small rosettes or slightly extended layers, light green with *usually a purple margin.* Thallus 10–30 mm long and 6–8 mm broad, oblong or obcordate with emarginate or bilobed apex, margins ascending, crenulate. Dorsal epidermal cells 4–6-angled with walls slightly and *angles much thickened.* Pores little elevated, with *5–6 concentric rings*, each of 6–8 cells *having thickened angles.* Ventral surface purple; scales imbricate, in one row on each side of the midrib, obliquely lunate, with *two linear acute appendages.* Chlorophyll-bearing layer strongly developed, occupying *about half the midrib* and almost the whole of the lamina. Midrib thick, gradually passing into the lamina ending in a 1-celled margin. Peduncle of ♀ inflorescence 15–25 mm long. Capsule-wall of a single layer of cells, *without annular thickenings.* Spores 65–76 μ in diam., rounded-tetrahedral, with a few large areolae and broad crenulate margin, brownish-yellow.

Hab. On rocks and on soil among rocks in rather dry places.

Distrib. N. to Caithness, uncommon; Ireland. Fr. March–July.

The smooth papery surface of the dorsal epidermis when dry, and the section of the thallus, render sterile plants of this species easily known. In all our other species, except *Dumortiera*, the air-chambers are distinct in one layer, but in *Reboulia* laminae are developed from the walls and roof of these chambers and form irregular secondary ones which occupy a large part of the midrib and give it a honeycombed appearance. This species is not rarely confused by beginners with *Preissia* with which it has some, though an entirely superficial resemblance; but besides the above characters it can be distinguished from *Preissia* by the thickened angles of the epidermal cells, the simple pores, and the ventral scales having generally two appendages. When fertile, the long narrow scales at the base and apex of the ♀ peduncle and the sessile ♂ inflorescence can be noted.

As in the other species, the ♂ receptacle has small eminences on its upper surface, on each of which is a pore leading to an antheridial cavity. Between these eminences are barrel-shaped pores leading to air-chambers. Barrel-shaped pores are also found on the ♀ receptacle in this and the other species.

In *Reboulia*, *Conocephalum* and *Dumortiera* the ♀ receptacle is almost sessile on fertilization, or at least is very shortly raised above the surface, the peduncle becoming elongated only on the maturity of the spores. On these plants we find the ♂ receptacle to be sessile or nearly so.

Marchantioideae-Compositae

Areolae on the dorsal surface of the thallus distinct. Air-chambers (except in *Dumortiera*) well defined, rarely divided by secondary walls. Capsule usually dehiscing by irregular valves, the wall with semi-annular thickenings (except in *Lunularia*). Usually more than one archegonium developed in each involucre of the receptacle.

This group contains the highest members of the *Marchantiaceae*. Leitgeb named it "Compositae" on account of the female receptacle representing a branch-system, i.e. the growing-point of the thallus which is to form the receptacle usually dividing repeatedly in a dichotomous manner, each new growing-point giving rise to archegonia in acropetal succession. In the "Operculatae," which received this name on account of the mode of dehiscence of the capsule, Leitgeb considered that the female receptacle represented a single branch, the growing-point of which gave rise to the receptacle and did not undergo dichotomy. The two groups are not sharply divided, and Cavers has suggested, as a result of his studies, that the female receptacle of all the *Marchantiaceae*, except *Clevia* and *Plagiochasma*, will be found to show the "Composite" mode of development.

VI. CONOCEPHALUM Wigg.

Conocephalum Wigg., Prim. Fl. Hols. p. 82 (1780).
Fegatella Raddi, Opusc. scientif. di Bologna II p. 356 (1818).

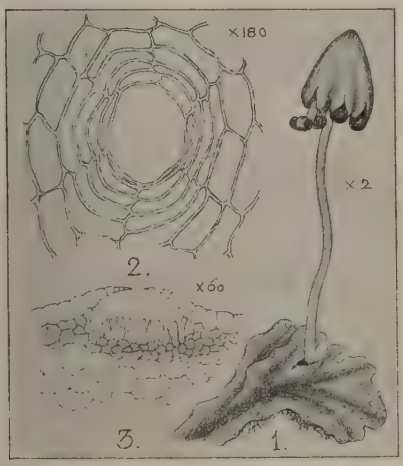
Thallus large, dichotomously branched; areolae very distinct, mostly hexagonal, *pores simple;* gemmae-cups absent. Chlorophyll-bearing layer shallow, air-chambers large, terminal cell of the filaments forming the floor produced into a *pointed colourless beak*. Peduncle of ♀ receptacle from the apex of a branch, long, with a *single root hair furrow; receptacle obtusely conical*, almost entire, composed of *5-8 tubular involucres*, each enclosing a single sporogonium. Pseudoperianth absent. Capsule with rather long pedicel, clavate-pyriform, dehiscing at maturity by throwing off an apical cap, the remainder splitting longitudinally by 4-8 reflexed valves. *Spores*

large, papillose, *many celled*, beginning to germinate while still within the capsule. Elaters 2–4-spiral, bluntly fusiform. Male receptacle disciform, papillose, *sessile* at apex of a branch, becoming apparently lateral, surrounded by the dorsal layers of the thallus.

Two species of this genus have been described, the common European plant which is widely spread in Northern Asia and America, and one from China and Japan.

18. Conocephalum conicum (L.) Dum.

Hepatica vulgaris Mich., Nov. Pl. Gen. p. 3 (1729).
Marchantia conica L., Sp. Pl. p. 1138 (1753).
Conocephalus conicus Dum., Comm. Bot. p. 115 (1822).
Fegatella conica Corda in Opiz, Beitr. 1 p. 649 (1829).
Hepatica conica Lindb., Hepat. utveckl. p. 5 (1877).



1. Fertile plant. 2. Pore. 3. Section through pore.

Dioicous. In *largely extended, dark green*, shining layers. Thallus 10–20 cm long and 8–10 mm broad, linear, flat with somewhat undulate margins and slightly channelled centre, the apex emarginate. Dorsal surface with *large areolae forming a regular network;* epidermal cells *thin-walled, angles not thickened*. Pores elevated, *visible to the naked eye, with 5–6* concentric rings of cells, the innermost ring composed of 6–7 cells. Ventral surface pale green, midrib conspicuous, scales rather *distant*, tender, in one row on each side, with a violet, *reniform or orbicular, appendage*. Midrib composed of small cells, somewhat suddenly passing into larger cells of the lamina ending in a generally 2-celled margin. ♀ peduncle 3–6 cm long, reddish below and hyaline above. Capsule-wall of a single layer of cells except at the apex, with annular thickenings. Spores 70–90 μ in diam., green, later reddish-brown. ♂ receptacle at first green, later purple.

HAB. On wet shady rocks.

DISTRIB. N. to Shetland, common, ascending to 3200ft. in the Highlands; Ireland. Fr. Feb.–April.

The large dark green shining patches on wet rocks, with the very distinct areolae and pores, and the pleasant scent when bruised, are unlike any of our other species. Both *Lunularia* and *Marchantia* nearly always have gemmae-cups present, and a section of the thallus shows the midrib very gradually passing into the lamina which has a broad 1-celled margin, while in *Conocephalum* the midrib passes rather suddenly into the lamina, and the margin is usually 2-celled. Moreover the long pointed beak of the terminal cell of the filaments forming the floor of the air-chambers, below the simple pores, will alone separate this species from any other of the family. In the fertile plant, the conical receptacle and large multicellular spores are notable. This species rarely fruits in the Highlands of Scotland, though it frequently does so in the south. Tubers are often formed on the ventral surface of the mid-rib; these become detached and form new plants.

Oil-bodies and mucilage-organs are well developed in this species. The former give the plant its scent and protect it from being eaten by snails. The mucilage occurs either in longitudinal rows of confluent sacs or as isolated cells. Goebel considers that their function is for storage of water.

The stalk of the ♀ receptacle is delicate and soon withers. The spores are multicellular because they begin to germinate when within the capsule. This does not happen in the other *Marchantiaceae*, but can be seen in *Pellia*.

Cavers mentions that two antheridia may occasionally be seen in one cavity.

VII. LUNULARIA Adans.

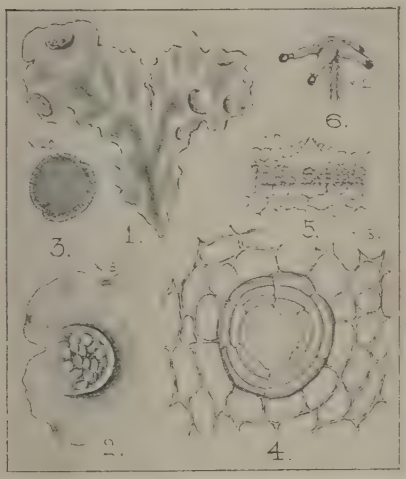
Lunularia Mich., Nov. Pl. Gen. p. 4 (1729).
Lunularia Adans., Fam. Pl. p. 15 (1763).

Thallus large, irregularly furcate or innovating from the apex, the dorsal surface distinctly areolate when moist, with *semilunar gemmiferous receptacles* always present; *pores simple*. Chlorophyll-bearing layer narrow. Peduncle of ♀ receptacle from a sinus of the thallus, *without a root-hair furrow*, *hairy*, surrounded at the base with scales in several layers; receptacle almost entirely composed of *four cruciate*, *horizontal*, *tubular involucres*, each containing a single sporogonium. Pseudoperianth absent. Capsule rather longly pedicellate, exserted from the bilabiate involucre, dehiscing nearly to the base by four narrow valves. Cells of capsule wall *without annular thickenings*. Elaters bispiral, thread-like. ♂ receptacle disciform, *sessile at apex of a short branch*, becoming, as with the ♀ receptacle, apparently lateral, surrounded except in front by the elevated border of the thallus.

The solitary species of this genus is widely distributed in warm regions. It is native in the Mediterranean region, and possibly in the south of England and south-west of Ireland. Throughout the other parts of Europe it has spread by means of gardens, flower-pots, etc.

19. Lunularia cruciata (L.) Dum.

Lunularia vulgaris Mich., Nov. Pl. Gen. p. 4 (1729).
Marchantia cruciata L., Sp. Pl. p. 1137 (1753).
Lunularia cruciata Dum., Comm. Bot. p. 116 (1822).



1. Thallus with gemmiferous receptacles. 2. Receptacle with gemmae. 3. Gemmae. 4. Pore. 5. Section through pore. 6. Female inflorescence.

Dioicous. In extended dense layers of a *light green* colour, somewhat shining, becoming *brownish-yellow with age*. Thallus 1·5–2·5 cm long and 6–11 mm broad, obcordate and emarginate at the apex, flat or slightly concave, margin hyaline, sinuate. Dorsal epidermal cells 5–6-angled, generally *thickened*, at least at the angles, and sometimes markedly incrassate, but not infrequently with walls and angles thin. Pores conspicuous, *highly elevated*, with 5 concentric rings, each of 6 hyaline cells. Ventral surface green, scales in one row on each side, *very tender*, hyaline, *broadly lunate with a rotundate appendage*, several cells having oil-bodies. Midrib but little prominent below, 20–25 cells thick in the middle, very gradually passing into the lamina ending in a 1-celled margin 3–4 cells wide. Chlorophyll-bearing layer with 2–3-celled branched filaments. ♀ peduncle 2–2·5 cm long, delicate, nearly pellucid, with scattered hairs or almost naked. Capsule dark brown, oval, of one layer of cells. Spores 14–17 μ in diam., rounded-tetrahedral, smooth, yellowish-brown. Elaters very long and slender, yellowish-brown.

Gemmae grouped in cavities having a semilunar fold of the epidermis on the postical side, lenticular, vertically inserted, with a 1-celled hyaline pedicel and a closed sinus at each side.

HAB. In flower-pots and gardens, spreading to moist rocks in the neighbourhood.

DISTRIB. N. to Kincardine, rarer towards the north; Ireland; perhaps a native of the south of England and south-west of Ireland. Fr., very rare, August?

This is a more common species in this country than *Marchantia* and was usually mistaken for it by the older authors; it has doubtless increased greatly within the last century. It can be recognised by the gemmae-cavities, with their crescent-shaped, entire margin, which are almost always present; the brownish-yellow colour of the older parts of the thallus is also unlike that of the other species. The pores are conspicuous in the moist plant and are more elevated than in *Marchantia*. The concentric rings of the pores are rather difficult to detect on account of the hyaline cells composing them being almost superimposed on one another, and the inner cells being frequently torn.

VIII. DUMORTIERA Reinw. Bl. et Nees

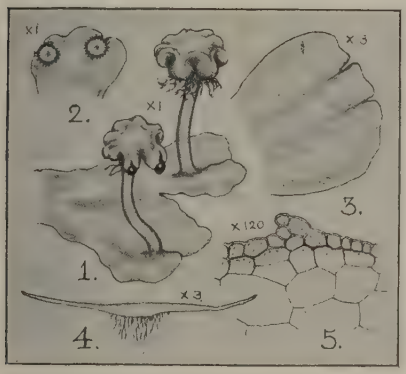
Dumortiera Reinw. Bl. et Nees, Nova Acta Leop. Carol. VII p. 410 (1824).

Thallus large, dichotomously branched and innovating from beneath the apex, *thin and soft*, or more rarely coriaceous, *without pores* or *permanent air-chambers*, the *latter only indicated by indistinct areolation;* gemmae-cups absent. Ventral scales *greatly reduced*. Peduncle of ♀ receptacle with two root-hair furrows, with barbate chaffy scales at the base and apex: receptacle disciform, convex, with a few bristle-like hairs, with *6–10 short rays*, under each being one saccate, *horizontal* involucre enclosing a single sporogonium. Pseudoperianth absent. Capsule with a short pedicel, deeply dehiscing by 4–8 valves. ♂ receptacle disciform, depressed in the centre, on a short peduncle with two root-hair furrows.

A tropical genus of which three species are known. Our *D. hirsuta* is found in some quantity in the south-west of Ireland and very sparingly in the south of England, also in Italy. It is widely distributed on the tropical islands of both hemispheres.

20. Dumortiera hirsuta (Sw.) Reinw. Bl. et Nees

Marchantia hirsuta Sw., Prodr. Fl. Ind. Occ. p. 145 (1795).
Marchantia irrigua Wils. M.S. in Hook., Eng. Flora p. 106 (1833).
Dumortiera hirsuta Reinw. Bl. et Nees, Nov. Act. Leop. Carol. VII p. 410 (1824).
Dumortiera irrigua Nees, Eur. Leb. IV p. 159 (1838).
Dumortiera hirsuta var. *irrigua* Spruce, Hep. Amaz. et And. p. 566 (1885).



1. Fertile Plant. 2. Male inflorescence.
3. Apex of young thallus.
4. Transverse section of thallus.
5. Portion of do., enlarged, showing ridge cut across.

Dioicous and monoicous. In extended *dark green* layers. Thallus 7–10 cm long and 8–12 mm broad, frequently being furcate at the apex which is rounded and deeply emarginate; flat or slightly concave, margin very slightly undulate; *partly or wholly translucent* with the midrib appearing conspicuous. Dorsal surface with a *faint network of ridges*, most evident in the younger parts; epidermal cells 4–6-angled with *thin walls and angles not thickened.* Ventral surface pale green with rather numerous long yellowish smooth rhizoids on the midrib and *scattered as bristles over the lamina and margin; tuberculate rhizoids few; scales evanescent* on both sides of the midrib. Midrib rather prominent below, 14–16 cells thick in the middle, the lower two-thirds of small cells, the remainder large and occupying the entire lamina except one smaller row on the dorsal and ventral surfaces; the midrib very gradually passing into the margin of 3 strata of cells, 6–7 cells wide. Peduncle of ♀ receptacle 12–23 μ long, thick, reddish-brown. Capsule globose, reddish-brown, of one layer of cells, the wall with numerous annular thickenings. Spores 22–28 μ in diam., roundish-oblong, thickly and coarsely papillose, yellowish-brown. Male receptacle with bristle-like hairs on the side.

Hab. On dripping rocks in shade.

Distrib. S. of England; Ireland. Rare.

This rare species is confined to shady places where there is a constant trickle of water. The soft and thin, partly translucent thallus, with its absence of pores and faint network of ridges, does not resemble our other species. The thallus is usually only coriaceous when growing in an abnormal, that is a dry, situation. A section shows the absence of air-chambers. They are laid down at the growing point, but disappear later, the tissue becoming thus composed of almost uniform cells enlarged towards the centre and not differentiated as in our other *Marchantiaceae*.

The smooth rhizoids on the ventral surface are transformed into bristles on the lamina and margin. Tuberculate rhizoids, with their principal function of storing water, are little required in a hygrophilous plant such as *Dumortiera*, nor are their protecting ventral scales necessary.

Douglas Campbell found that in *D. trichocephala*, air-chambers are not laid down even in the young plant.

D. hirsuta is sometimes, at least, undoubtedly monoicous, as pointed out to me by Mr. Nicholson in specimens from Sussex (*Hast. & E. Suss. Nat.* p. 261, 1911).

IX. PREISSIA Corda

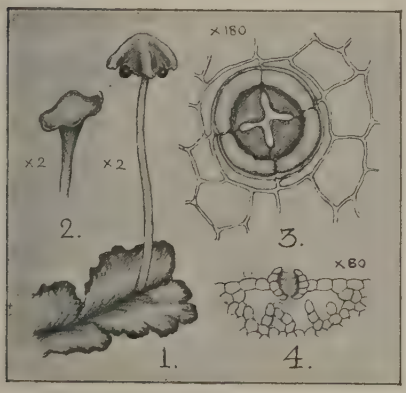
Preissia Corda in Opiz, Beitr. 1 p. 647 (1829).
Chomocarpon Corda, op. cit. p. 647 (1829); Lindb. Hepat. utveckl. p. 6 (1877).

Thallus branching principally by ventral innovations from the apex of plants bearing infloresence, sterile plants often dichotomous. *Air-chambers distinct*, filled with the frequently branched chlorophyll-bearing filaments; pores *compound* (barrel-shaped). Gemmae-cups absent. Ventral scales large. Peduncle of ♀ receptacle long, *with two root-hair furrows;* receptacle hemispherical, *with 3–4 cruciate rays* dividing the margin into short lobes, under each being one involucre containing an *inflated pseudoperianth* with 2–3 capsules. Capsule longly pedicellate, slightly exserted, subglobose, dehiscing to about the middle by 6–7 irregular, revolute valves, the cap breaking up. ♂ receptacle less longly *peduncled*, *circular*, with scales on the under surface.

Only one species is known in the genus, widely distributed in mountainous regions.

21. Preissia quadrata (Scop.) Nees

Marchantia quadrata Scop., Fl. Carn. ed. 2 p. 355 (1772).
Marchantia commutata Lindenb., Syn. Hep. p. 101 (1829).
Preissia quadrata Nees, Eur. Leb. IV p. 135 (1838).
Preissia commutata Nees, Eur. Leb. IV p. 117 (1838).
Chomocarpon quadratus Lindb., Hepat. utveckl. p. 6 (1877).



1. Fertile thallus. 2. Male receptacle. 3. Pore. 4. Section through pore.

Dioicous and monoicous. In small, or rather extended, thin *pale green* patches. Thallus to 3 cm long and 5–10 mm broad, ligulate, nearly flat above, *margin thin, wavy, reddish-brown;* innovations obcordate, bilobed. Dorsal surface with *distinct areolae;* epidermal cells 4–6-angled, mostly quadrate at the margin, *thin walled, angles not thickened.* Pores small, *somewhat conspicuous, with 4–5 superimposed concentric rings of cells, circular above* with two rings, each of 4–6 cells, *cruciate below* with 4 larger cells. Ventral surface reddish-brown, scales *imbricate* in one row on each side of the midrib, semilunar with a small *lance-shaped appendage.* Midrib prominent below, with some longitudinal brown fibrous bands present, rather suddenly passing into the lamina, ending in a 1-celled margin 3–4 cells wide. ♀ peduncle to 5 cm long, reddish-brown below. Capsule-wall of one layer of cells with numerous annular thickenings. Spores 50–60 μ in diam., reddish-brown, coarsely reticulate. ♂ peduncle to 2 cm long, with two root-hair furrows.

Hab. On moist soil among rocks in the subalpine and alpine regions, and in moist hollows on sand-dunes. Most frequent on limestone.

Distrib. From Carnarvon and Derby to Shetland, frequent; Ireland. Fr. June–August.

The barrel-shaped pores separate this from all other species, except *Marchantia*, with which it is not likely to be confused. In addition to the notes given under *Reboulia*, the present plant differs from that species in the ♀ peduncle having two root-hair furrows, the different receptacle, the presence of a pseudo-perianth and of annular thickenings on the capsule-wall, the sclerenchyma-fibres in

the midrib, etc.; it is also a subalpine species, being not infrequent on the higher hills and preferring wetter rocks; the patches are also usually more extensive and less commonly in rosettes. It is sometimes seen in abundance on wet calcareous rocks by the side of streams.

Small forms of *Conocephalum* bear some resemblance to wet ground forms of this species, but the latter can be distinguished with the lens by the smaller areolae of the dorsal surface, and by the imbricate ventral scales.

The ♀ receptacle occasionally bears antheridia as well as archegonia, and this probably suggested to some of the older botanists the name *Marchantia androgyna* for *Preissia* among other species. The dorsal surface of the receptacle has barrel-shaped pores as on the thallus.

The ♂ receptacle is circular but with a somewhat irregular margin which is thin and membraneous. Each of the small protuberances on the dorsal surface has a small pore leading to the chamber containing a single antheridium.

The cut ends of the sclerenchyma-fibres can be seen in a transverse section of the midrib. They are scattered and have brown walls; they serve principally for the storage of water.

Mycorhiza are more plentiful in this species than in our other *Marchantiaceae*. A well-marked infected zone of cells with hyphae can be seen on the midrib. The cells have purple walls.

Preissia and *Reboulia* were not clearly separated by our older authors. The name *Marchantia hemisphaerica* included both in some cases, or *Preissia* was more or less defined under the name *Marchantia androgyna*.

Lindberg made *P. commutata* a subspecies of *P. quadrata*, differing chiefly in its being very frequently dioicous and with the ♀ receptacle almost semiglobose, scarcely cruciate, and with more numerous involucres; also the whole plant being smaller and the thallus narrower. In this he has been followed by most Scandinavian botanists. I have not been able to find the corresponding difference in the ♀ involucre on these narrow forms which frequently occur on the Highland mountains.

X. MARCHANTIA L.

Marchantia Marchant-Fil. in Mém. Acad. Paris p. 230 (1713).
Marchantia L., Sp. Pl. p. 1137 (1753).

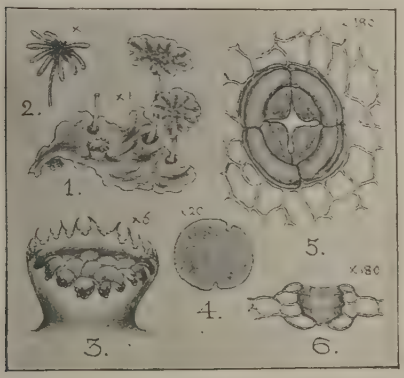
Dioicous. Thallus richly dichotomously branched with broad midrib and hexagonal areolae. *Goblet-shaped gemmae-cups with fringed margin* almost always present on the dorsal surface. Chlorophyll-bearing layer narrow, the filaments frequently branched; *pores compound* (barrel-shaped). Peduncle of ♀ receptacle with two root-hair furrows; *receptacle stellate* with *4–10 elongated rays*, each with a root-hair canal underneath; involucres 2-valved, *fimbriate*, *alternating with the rays*, enclosing *several* sporogonia, each surrounded by a pseudo-perianth. Capsule longly pedicellate, dehiscing to below the middle

by irregular valves. ♂ *receptacle longly peduncled*, disciform, stellately or palmately lobed.

Stephani describes 67 species belonging to this genus, nearly all being tropical or subtropical. Besides the widely spread *M. polymorpha*, Europe has another species in *M. paleacea* which is confined to the south and which also occurs in the Atlantic islands.

22. Marchantia polymorpha L.

Marchantia polymorpha L., Sp. Pl. p. 1137 (1753).



1. Male plant with gemmiferous cup.
2. Female inflorescence.
3. Cup with gemmae. 4. Gemma. 5. Pore.
6. Section through pore.

Dioicous. In extended *deep green* patches or smaller rosettes. Thallus 2–10 cm long and 7–20 mm broad, flat or slightly concave, margin sinuate-lobed, the apex emarginate. Dorsal surface with *frequently a dark line along the middle*, areolae somewhat distinct; epidermal cells 5–6-angled, *thin walled, angles not thickened.* Pores not visible to the naked eye, little elevated with *4 superimposed concentric rings*, each of 4 cells, appearing *oval* from above with two rings of cells, and cruciate below. Ventral surface brownish, the tuberculate and the smooth yellowish rhizoids numerous; scales in *three rows on each side*, those at the margin *broadly ligulate*, hyaline or purple. Midrib scarcely prominent below, *very gradually* passing into the lamina ending in a 1-celled margin 3–8 cells wide. ♀ peduncle 3–5 cm long, dark red or green. Capsule oval, the wall of one layer of cells with annular thickenings. "Spores spherical, 12 μ, nearly smooth" (Heeg). Elaters 2-spiral, very long and narrow. ♂ receptacle less longly peduncled, *with 8 short rounded lobes*. Gemmae *rotund-reniform, nearly flat*, vertically inserted, with a 1-celled hyaline pedicel, and an open sinus at each side, in groups at the bottom of the *goblet shaped gemmae-cups* which have a lobed and *spinous-ciliate* margin.

var. **aquatica** Nees, Eur. Leb. IV p. 65 (1838).

Submerged; thallus *erect or suberect*, *elongated*, linear to linear-cuneate, *thin*, with a *distinct median dark line*, nearly flat, the margins undulate-crenate, peduncles elongated.

var. **alpestris** Nees, loc. cit. p. 70 (1838).

In dense compact patches *in the alpine region;* thallus prostrate, *thick and rigid*, green, without a median dark line, more or less channelled, the margins undulate-lobate, peduncles shorter.

HAB. Moist walls, gardens and waste heaps, also in marshes and at sides of streams.

DISTRIB. N. to Shetland, rather common but rarer towards the north; Ireland. Var. *aquatica*, in bogs. Var. *alpestris*, on soil on the higher mountains of Perth and Aberdeen. Fr. very rare, July.

Is readily known by the fringed gemmae-cups which are almost constantly present, also frequently by the black line along the middle of the thallus. ♂ and ♀ receptacles are common and are distinctive. The ventral scales are in three rows on each side of the midrib. The pores are barrel-shaped, their surface view being also distinct from those of *Conocephalum* and *Lunularia;* the latter has generally also thickened walls of the epidermal cells of the thallus.

The rays of the ♀ receptacle are incurved in the young state, so that drops of water containing spermatozoids pass down in the grooves between them and reach the archegonia. The rays spread out if the sporogonia develop.

Air-chambers and pores are only slightly developed in the var. *aquatica*, and are absent in parts of the thallus. Ruge has shown that where the air-chambers do exist, the pores are closed by a papilla-like outgrowth of the lower row of cells. The black line along the middle of the thallus is owing to the absence of air-chambers in that part.

Order III.

JUNGERMANNIALES

Fam. IV. JUNGERMANNIACEAE ANACROGYNAE

Gametophyte *generally a thallus*, more rarely a stem with leaves. *Archegonium arising from behind the apical cell* (except in *Calobryum*), the sporogonium being therefore dorsal, or only apparently terminal. Involucre of the sexual organs *never representing leaves.* To this group belong all the thallose and intermediate forms, and the foliose but multilateral and aberrant genera *Haplomitrium* and *Calobryum*.

1 { Plant with distinct leaves 2
  { Plant without distinct leaves 3

2 { Stem prostrate, leaves in two rows; rhizoids purple ... *XVIII. Fossombronia*
  { Stem erect, leaves in three rows; rhizoids absent ..... *XIX. Haplomitrium*

3 { Thallus with lamellae on the dorsal surface ..... *XVII. Petalophyllum*
  { Thallus without lamellae 4

4 { Thallus with hairs on the margin and midrib ..... *XII. Metzgeria*
  { Thallus without hairs 5

5 { Ovate toothed scales present on the ventral surface; margin of thallus lobed, with dark opaque spots in the substance at the base of the lobes *XVI. Blasia*
Ovate toothed scales absent on the ventral surface; dark spots absent.....6

6 { Cross-section of thallus showing a central strand of narrow, thickened cells *XIII. Pallavicinia*
Central strand absent 7

7 { Inflorescence on the dorsal surface of the thallus 8
Inflorescence on short lateral branches, thallus narrow, more or less pinnate .....*XI. Aneura*

8 { Female involucre forming a complete or (in *P. epiphylla*) an incomplete cylinder; antheridia beneath warty eminences on the surface of the thallus .....*XV. Pellia*
Female involucre laciniate-dentate, or lobate, to near the base; antheridia beneath toothed scales on the surface of the thallus .....*XIV. Moerckia*

Subfamily **Metzgerioideae**

Aneureae Dum.; *Metzgerieae* Spruce

Thallus fleshy or membranous, frequently with a sharply defined midrib and a lamina composed of one layer of cells. ♂ *and* ♀ *inflorescence on very short branches which form the receptacle*, the ♂ as well as the ♀ being arranged more or less regularly in two rows on the upper side of the branch. Capsule ovate or cylindrical, 4-valved, composed usually of two layers of cells, of which the inner possesses more or less distinct semi-annular thickenings. Elaters either attenuate at each end and with *one broad spiral thickening*; or *as elater-bearers*, short and obtuse, with an indistinct spiral thickening, and *persistent as erect tufts at the apex of the valves.*

This subfamily includes the *Aneureae* and *Metzgerieae* of Nees. They were retained as distinct divisions by him principally on account of the different position of the inflorescence. In this he is followed by several authors.

XI. ANEURA Dum.

Riccardia S. F. Gray, Nat. Arr. Brit. Pl. 1 p. 683 (1821).
Aneura Dum., Comm. Bot. p. 115 (1822).

Thallus *fleshy*, often much branched and pinnate, with a broad *midrib never sharply defined* (in the European species); the inner cells usually larger than those of the cortical layer. Ventral branching rarely present. *Sexual organs arising from short lateral branches*, the ♀ by subsequent growth of the thallus appearing as if ventral. Margin of the ♀ branch laciniate enclosing the 2–8 biseriate archegonia. Pseudoperianth absent. Calyptra *large*, cylindrical or clavate, *fleshy*, always with papillae at the apex. Capsule longly pedicellate, oblong-cylindrical, 4-valved, of two layers of cells, with semi-annular thickenings variously present. Elaters attenuate, unispiral, the spiral band broad, red-brown. Elater-bearers *persistent as erect tufts on the apex of the valves*. Gemmae oval, usually 2-celled, *endogenous*.

More than 150 species of *Aneura* have been described, most being tropical or subtropical.

The ♂ and ♀ receptacles are ordinary lateral branches, but which develop more slowly, and the growth of which is stopped by the production of the antheridia and archegonia. Both of the latter are arranged singly in two rows, though this becomes indistinct in the ♀ branch after fertilization. The incurved margin of the ♀ branch is generally laciniate, that of the ♂ papillose.

The gemmae are endogenous, being formed within the cells of the thallus and becoming free through the rupture of the outer cell-wall. These are otherwise not known to be found among the *Hepaticae*, except in *Aplozia caespiticia*, where they arise endogenously at the apex of the swollen stem, according to Buch.

The species in this genus are mostly very difficult to distinguish from one another, especially when dried. The characters vary greatly, the inflorescence is very often difficult to determine, and is also frequently absent. Thin sections of the thallus are necessary in most cases. They are easily made and are sufficient in themselves to distinguish the species in their typical forms, but the student will have a good deal of uncertainty in many plants which come before him. In recent years the structure of the capsule-wall has been shown to give good differential characters between most of the European species, but they are very difficult to detect. It requires a high power and extremely delicate focussing to distinguish which of the two layers of the wall the structures in view belong to and their relation to each other, while thin sections of the wall, which are mostly necessary before one is certain of the layers, are by no means easy to make. Besides, capsules are not common, and are often very rare. The student will find the subject studied in Schiffner's "Krit. Stud. u. *Jung. sinuata* etc." in *Lotos*, 1900, No. 8., and in his "Bemerk. u. *Riccardia major* S.O. Lindb." in *Oest. bot. Zeit.* 1906, Nr. 5/6. Notes will also be found in Warnstorf's "Krypt. d. Mark Brand." 1903, pp. 110, 111.

1 { Thallus broad, thick and greasy, with raised margins; (dioicous)...*23. pinguis*
{ Thallus narrow, ·5–2 mm broad, not thick and greasy.....2

2 { Thallus semilunar in section, 5 cells thick in the middle, simple or slightly branched; (dioicous) ..... *24. incurvata*
{ Thallus biconvex or plano-convex in section, usually with many branches...3

3 { Ultimate branches with a unistratose margin 2–3 cells broad, section biconvex ..... *25. multifida*
{ Ultimate branches with a unistratose margin 1 cell broad or obsolete 4

4 { Thallus pinnate or bipinnate 5
{ Thallus palmate or irregularly branched.....6

5 { Section of main stem 6–9 cells thick in the middle.....*26. sinuata*
{ Section of main stem 5, seldom 6, cells thick in the middle .....*27. major*

6 { Thallus with irregular branches frequently broadened towards the end, section of main stem plano-convex, 5–6 cells thick in the middle; monoicous *28. latifrons*
{ Thallus frequently palmate with branches narrowed towards the end, section biconvex, 6–9 cells thick in the middle; dioicous.....*29. palmata*

✓ 23. Aneura pinguis (L.) Dum.

Jungermannia pinguis L., Sp. Pl. ed. 1 p. 1136 (1753); Hook., Brit. Jung. *pl.* 46 (1813).
Riccardia pinguis Gray, Nat. Arr. Brit. Pl. 1 p. 684 (1821).
Aneura pinguis Dum., Comm. Bot. p. 115 (1822).

1. Fertile plant. 2. Male plant with branch enlarged. 3. Epidermal cells. 4. Section of thallus. 5. Central portion of do.

Dioicous. In flat dark green or yellow-green patches. Thallus 2–3 cm long or more and *2–6 mm broad*, simple or with a few irregular branches, hardly pinnate, rounded at the apex, *fleshy and brittle*, opaque, convex beneath with *somewhat numerous rhizoids, the margins ascending*, crisped or occasionally flat. Cross-section *10–12* cells thick in the middle, the outer cells smaller than the inner, plane or slightly concave above, broadly convex below, gradually passing into the thinner but obtuse 1–3-stratose margin. ♀ branch from the *base of a sinus*, covered by the margin of the thallus, shortly laciniate at the apex. Calyptra to 10 mm long, cylindrical, nearly smooth. Capsule oblong, outer layer of capsule-wall with reddish-brown nodular thickenings on the radial walls, *inner layer with*

semi-annular thickenings. Spores 20–24 μ in diam., reddish-brown, minutely papillose. ♂ branch oblong, sometimes geminate, with 3–4 pairs of antheridia, the margin crenulate or dentate.

var. **angustior** Hook., Brit. Jung. p. 46 *pl.* 46 f. 2 (1813).

Thallus prostrate, or suberect when submerged, rather elongate, *linear*, narrow, ·5–2 mm broad, channelled, *generally simple*, occasionally with a few *narrow*, *linear* branches.

var. **denticulata** Nees, Eur. Leb. III p. 428 (1838).

Thallus prostrate, in thin layers, *crisp*, *small and narrow*, to 15 mm long and ·25–1 mm broad, slightly channelled, simple or less frequently with 1–3 branches, but generally *appearing very shortly pinnate* on account of the frequent inflorescence branches.

Hab. In marshes, ditches and among wet rocks. Var. *angustior*, submerged in pools, or in marshes. Var. *denticulata*, creeping over compact moss tufts and on wet rocks, chiefly when calcareous.

Distrib. N. to Shetland, common, ascending to 3300 ft. in Perthshire; Ireland. Fr. April–August. The varieties less common.

The thick, greasy thallus with its few branches and crisped ascending margins distinguish this species. The ♂ plant is often conspicuous in having much inflorescence. Some narrow forms of *Pellia* are apt to be confused with this species. They can be readily distinguished by the apex of the lobes being distinctly and rather deeply emarginate, and at the base of this sinus there is a small green swelling to be seen on the underside. In the *Aneura* the apex of the lobe is rounded and the small knobby swelling is never seen. In *Pellia* moreover the branching is dichotomous, and not at all pinnate. Less certain differences are, that the midrib of *Pellia* is more distinct, rhizoids generally more numerous, and the plant darker in colour; frequently also the distinctive ♂ inflorescence is present.

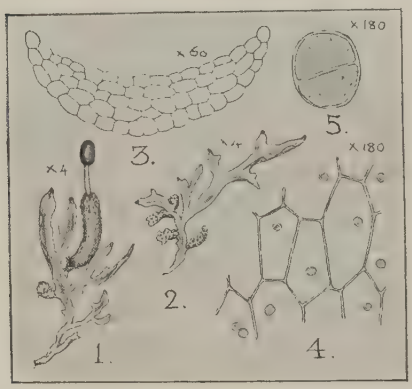
The varieties are much narrower than the type and might be confused with other species, but some stems will nearly always be found which have the characteristic greasy appearance, the numerous rhizoids, and the raised margins of *A. pinguis*. The var. *angustior* differs from the other variety in its thallus being usually simple, or if branched, by the branches being linear and very narrow. It is never more than subpinnately branched and has not the shortly pinnate and crisped appearance of the other. In the var. *denticulata* especially, the stem often lengthens into a long and narrow, unbranched extremity which readily breaks off.

Nees in *Eur. Leb.* III p. 427 (1838) separates the large forms of this species into two chief divisions, *a.* 1. *Crassior* and *a.* 2. *Tenuis*. The former grows on clay, sandstone or on sandy ground. An interesting plant, which may be considered as an extreme form of this, occurs in the damp hollows of some of our sand-dunes. It grows in flat circular patches, sometimes of several inches in diameter, closely appressed to the substratum, but with the margins elevated; the thallus is thicker than in any of the other forms. *a.* 2. *Tenuis* is the commoner plant and is found most frequently in bogs and marshes. It is a more slender plant with the thallus more elongate and sometimes very slightly or not

at all divided. It varies considerably in size and in the amount of branches, and forms loose patches or creeps as solitary stems among bog-mosses. It is however much larger than the varieties *angustior* and *denticulata*.

24. Aneura incurvata (Lindb.) Steph.

Riccardia incurvata Lindb., Musc. Scand. p. 5 (1879).
Aneura incurvata Steph., Spec. Hep. I p. 268 (1899).



1. Fertile plant. 2. Male plant. 3. Section of thallus. 4. Epidermal cells. 5. Gemma.

Dioicous. In *pale green* patches or as scattered stems among mosses. Thallus to 15 mm long and ·5–1 mm broad, *simple or with a few* nearly horizontal *branches*, seldom bipinnate, linear, of the same breadth throughout, *channelled above*, the 1-celled margin somewhat transparent, apex of branches emarginate, or subacute when gemmiferous. The cross-section *semilunar*, *5*, seldom 6 cells thick in the middle, the branches 4–5 cells thick, *outer cells as large as the inner*. ♀ branch shortly laciniate. Calyptra 3·5 mm long, cylindrical, papillose. Outer layer of capsule-wall with nodular thickenings, *absent* or indistinct *in the inner layer*. Spores 20–25 μ in diam., brown, papillose. ♂ branch ovate to linear, with 3–5 pairs of antheridia, the *walls of the loculi raised* with unequally sized cells giving it a papillose appearance, the margin crenulate. Gemmae nearly spherical, 2–3 celled, in *great quantity* at the apex of stem and branches.

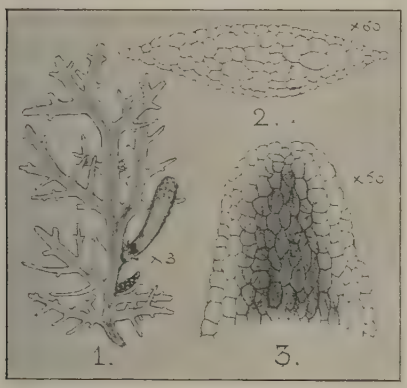
Hab. In moist sandy ground.

Distrib. N. to Berwick, rare.

Is readily known by the semilunar section of the thallus. The pale green colour of the most commonly nearly simple thallus, which is channelled above, and the numerous gemmae serve frequently to distinguish it in the field. It is more likely to be confused with *A. latifrons* or *A. multifida* than with the others; sections of the thallus will distinguish them in doubtful cases, and the latter species are monoicous.

25. Aneura multifida (L.) Dum.

Jungermannia multifida L., Sp. Pl. ed. 2 p. 1602 (1762).
Riccardia multifida Gray, Nat. Arr. Brit. Pl. 1 p. 684 (1821).
Aneura multifida Dum., Comm. Bot. p. 115 (1822).
Aneura ambrosioides Pears., Hep. Brit. Isl. p. 453 *pl.* 201 (1902).



1. Plant showing monoicous inflorescence.
2. Section of thallus. 3. Apex of branch.

Monoicous. In loose dark green or reddish-brown tufts or patches. Thallus to 3 cm long, *regularly 2–3 pinnate*, branches crowded, *linear*, usually *narrowed* towards the rounded or emarginate *apex*, ·3–·5 mm broad, the margins more or less crenulate, *transparent*, giving the branches the *appearance of being winged*. Cells of dorsal surface with slightly thickened walls. Cross-section *biconvex*, 6–7 cells thick in the middle, the inner cells *much larger* than the outer, the unistratose margin *2–3 cells in width*. ♀ branch with several short laciniae. Calyptra 3–5 mm long, narrowly clavate, papillose. Capsule cylindrical, dark brown ; cells of outer wall with semi-annular thickenings which are *absent in the inner wall*. Spores 13–16 μ in diam., pale yellowish-brown, nearly smooth, *translucent*. Elaters 250–500 μ long and 12–15 μ broad. ♂ branch oblong, margin crenulate. Gemmae oval-oblong, 2-celled, at the ends of the branches.

Hab. In ditches, marshy ground and on wet rocks.

Distrib. N. to Shetland, common, ascending to 3200 ft. in the Highlands ; Ireland. Fr. April–July.

Usually known without difficulty by the broad unistratose margin of the branches. This is most conspicuous in wet ground. In drier places the margin is less evident, but can generally be noted towards the end of the branches. The always thin margin, with the section almost always biconvex, and the branches linear and regularly bipinnate, distinguish this plant from the others.

A. ambrosioides Pears. is a form of wetter ground, darker in colour, always much branched, the branches narrow, and narrowed towards the end, the translucent margins very distinct and more frequently crenulate ; section of main stem 6–7 cells thick in the middle, the cortical cells very distinctly marked on account of their walls being dark brown. It is only an extreme form of the typical *A. multifida* and is connected with it by numerous intermediate forms.

26. Aneura sinuata (Dicks.) Dum.

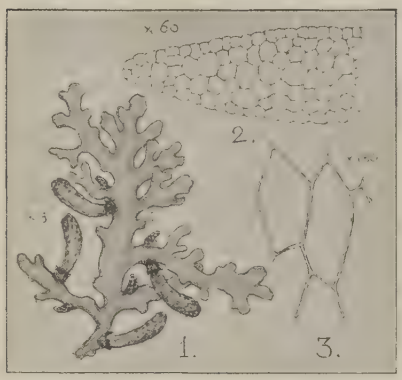
Jungermannia sinuata Dicks., Pl. Crypt. Fasc. 2 p. 16 (1790).

Jungermannia multifida β sinuata Hook., Brit. Jung. *pl.* 45 f. 2 (1813).

Aneura sinuata Dum., Comm. Bot. p. 115 (1822).

Aneura pinnatifida Nees p.p., Eur. Leb. III p. 442 (1838).

Riccardia latifrons β sinuata Lindb., Hep. in Hib. lect. p. 513 (1875); Musc. Scand. p. 5 (1879).



1. Plant showing monoicous inflorescence. 2. Section of thallus. 3. Epidermal cells.

Monoicous. In loose pale green patches, frequently submerged under water. Thallus 1–4 cm long and ·5–1·5 mm broad, *irregularly pinnate or bipinnate*, the branches *varying greatly* in size, most frequently gradually *narrowed to the base*, the apex being *broad* and obtuse, margins more or less sinuate, *not transparent*. Cells of dorsal surface with thin walls. Cross-section of main stem *nearly flat on both sides*, being slightly concave above and slightly convex below, *6–9* cells thick in the middle, the margin commonly 1-celled, the inner cells larger than the outer; branches mostly 5 cells thick in the middle. ♀ branch with papillose margin, not laciniate. Calyptra clavate, papillose. Capsule yellowish-brown; cells of outer wall with broad semi-annular thickenings, *the inner wall with paler coloured, narrow semi-annular thickenings*. ♂ branch short, ovate, margin crenulate, with 3–4 pairs of antheridia.

Hab. In springs, ditches and on dripping rocks, always in very wet places.

Distrib. N. to Cumberland, uncommon; Ireland.

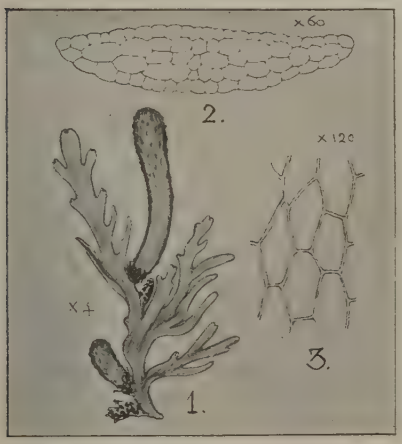
Distinguished from *A. multifida* by the very irregular branching, the branches broadened at the end, margin not transparent, of one layer of cells, section of more nearly the same thickness throughout, 6-8, or occasionally more, cells thick in the middle and not biconvex. *A. latifrons* is generally a smaller plant, translucent when moist and with different section of thallus, but aquatic forms of these species bear much resemblance to one another.

An extreme form of the submerged plant is the *forma submersa* Jensen in K. Müll. *Rabh. Krypt. Fl. Leb.* p. 339. The thallus is thin, 4–6 cm long and 1–1·5 mm broad, with a few long, and several very short, branches. This has been gathered by the Rev. C. H. Waddell in a deep well at Saintfield, Co. Down. The typical plant sometimes forms considerable patches on dripping rocks near waterfalls, especially in the west of Ireland and in Wales.

27. Aneura major (Lindb.) K. Müll.

Riccardia major Lindb., Musc. Scand. p. 5 (1879); Schiffn. in Lotos No. 8 (1900).

Aneura major (Lindb.) K. Müll., Rabh. Krypt. Fl. p. 340 (1908).



1. Plant showing monoicous inflorescence.
2. Section of thallus. 3. Epidermal cells.

Monoicous. In pale green patches or scattered among mosses, in *moist but not wet ground.* Thallus to 3 cm long and 1–1·5 mm broad, *typically simply and slightly pinnate* with short branches of nearly equal breadth and rounded at the apex, but sometimes 2-3 pinnate, with branches of varying length and usually narrowed towards the base, the margins entire or sinuate, *not transparent.* Cells of dorsal surface with thin walls. Cross-section of main stem *resembling that of A. sinuata, but only 5 cells thick in the middle*, seldom to 6 cells thick at the base of the stem, the branches 4 cells thick in the middle, or occasionally only 3 cells thick, the margin 1 cell broad. ♀ branch with papillose margin. Calyptra 3-6 mm long, arcuate, cylindrical-clavate, papillose. Capsule oblong-cylindrical, dark brown; cells of outer and inner walls as in *A. sinuata.* Spores 15–21 μ, pale greenish-brown, nearly globose, thickly and minutely verruculose. Elaters 280–500 μ long and 10–14 μ broad, reddish brown. ♂ branch short, ovate, margin crenulate, with 3–4 pairs of antheridia.

Hab. On sides of ditches and on moist soil.

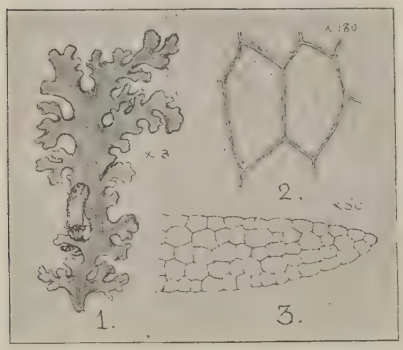
Distrib. N. to Lancashire, uncommon.

It is doubtful how far this is permanently distinct from *A. sinuata*. It is a plant of less wet ground and the thallus is thinner, a cross-section of the main stem showing generally only five layers of cells in the centre, and that of the branches only four or even three layers. It is also usually less branched and the main stem and larger branches are not broadened at the end as in the other, but the amount of branching varies greatly, and in the Sussex plant it is 2–3 pinnate on some of the specimens. In that plant the ultimate branches are sometimes slightly narrowed towards the apex.

A. major has only recently been distinguished from *A. sinuata* in Britain; it will probably be found to be the more frequent of the two plants.

28. Aneura latifrons Lindb.

Aneura palmata a. *major* Nees, Eur. Leb. IV p. 459 (1838).
Aneura latifrons Lindb., Bot. Notis. p. 62 (1873).
Riccardia latifrons Lindb., Hep. in Hib. lect. p. 513 (1875).



1. Plant showing monoicous inflorescence. 2. Epidermal cells. 3. Section of thallus.

Monoicous. In compact, flat, light green or yellow-green patches. Thallus 5–8 mm long and to 2 mm broad, the main stem closely attached to the substratum, the branches ascending, somewhat palmate, broadly linear or *cuneate*, usually *narrowed at the base*, the extremities *expanded* and rounded or emarginate, *translucent* when moist. Cells of dorsal surface 5-6 angled, *large*, with thin walls. Cross-section *flat above*, *convex below*, 5–6, commonly *5*, cells thick in the middle, the inner cells little larger than the outer, the *margin 1-celled*, apical branches 3–4, commonly *3*, cells thick in the middle, frequently concave above. ♀ branch with long laciniae. Calyptra 3 mm long, narrowly clavate, papillose at apex. Outer layer of capsule-wall with the radial walls nodular thickened, *inner layer with numerous broad semi-annular thickenings*. Spores 14–17 μ in diam., brownish-green, slightly papillose. ♂ branch generally near the ♀, *oblong*, *narrowed at base*, margin shortly laciniate. Gemmae oval, at the apex of the branches.

Hab. On peaty soil and on decaying logs and stumps in subalpine districts.

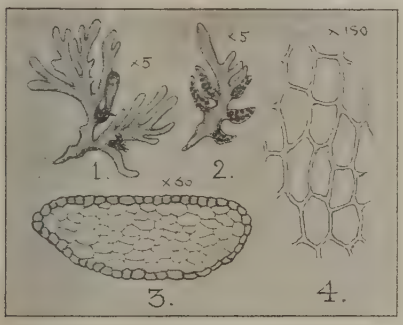
Distrib. N. to Shetland, uncommon; Ireland. Fr. May–July.

Differs from *A. palmata* by its larger size, more irregular branches which are broadened towards the end, the larger, thin-walled cells of the dorsal surface, the different section and the inflorescence. From *A. multifida* by the branches as above, the plano-convex section, 5 cells thick in the middle, the apical branches 3 cells thick, and the one-celled margin. The numerous sharply defined rings in the inner layer of the capsule-wall will distinguish this species from the others most frequently confused with it.

This species has a more northern distribution than *A. sinuata* and *A. major*. It is frequent in the West and North Highlands of Scotland, but becomes rarer southwards, especially in the drier districts.

29. Aneura palmata (Hedw.) Dum.

Jungermannia palmata Hedw., Theor. Gen. ed. 1 p. 87 (1784).
Aneura palmata Dum., Comm. Bot. p. 115 (1822).
Riccardia palmata Carruth. in Seem. Journ. Bot. 3 p. 302 (1865).



1. Fertile plant. 2. male plant. 3. Section of thallus. 4. Epidermal cells.

Dioicous. In compact flat patches, dark green, with the older parts *reddish-brown*. Thallus 5–10 mm long and ·2–·35 mm broad, the main stem closely attached to the substratum with *ascending or erect branches* from its entire length, the branches simple or furcate, or *palmate*, *linear*, frequently *narrowed* at the round, truncate or emarginate, *apex*, *opaque* when moist. Cells of dorsal surface 5–6-angled, rounded, smaller than in *A. latifrons*, with *thick walls* which are reddish-brown except in the younger parts. Cross-section *biconvex*, *6–9* cells thick in the middle, remaining some cells *thick to the margin*, the inner cells *distinctly larger* than the outer; apical branches *4 cells thick* in the middle. ♀ branch with a few short laciniae. Calyptra to 2 mm long, cylindrical, *strongly papillose*. Outer layer of capsule-wall with semi-annular thickenings, inner layer with slight nodular, but *without* semi-annular thickenings. Spores 12–15 μ in diam., brown, almost smooth. ♂ branch *linear*, thick, margin incurved, crenulate. Gemmae round or oblong, at the apex of the branches.

Hab. On decaying logs and on peat in subalpine districts.

Distrib. From Wales and Yorkshire to Shetland, uncommon; Ireland. Fr. June–Aug.

The nearly erect branches narrowed towards the end form a conspicuous character, but this is often not evident in the younger branches. It is the smallest species which we have. The section of the thallus does not resemble that of the others, and the dioicous character can very frequently be detected. In the field it is sometimes difficult to distinguish from *A. latifrons*, as although it mostly occurs on decaying logs and the latter on the ground, they are both to be found on peaty banks in the wetter districts, with much the same habit, *A. latifrons* also occasionally growing on decaying wood. The long linear ♂ branches of *A. palmata* sometimes occur in quantity, and can be seen with the lens.

XII. METZGERIA Raddi

Jungermannia L., Sp. Pl. p. 1136 (1753).
Metzgeria Raddi in Att. soc. scient. Mod. 18 p. 34 (1818).

Thallus membranous, *linear*, usually dichotomously branched with in addition very often ventral innovations arising from the side of the midrib. Midrib slender, *sharply defined* from the wings which are composed of *one layer* of pellucid cells, the underside of the midrib and the margin of the thallus having generally some 1-celled hairs. *Sexual organs on greatly reduced ventral branches.* ♀ branch forming an obcordate *hollow involucre furnished with hairs.* Pseudo-perianth absent. Calyptra thick and fleshy, claviform, *hairy*. Capsule shortly pedicellate, oblong-oval, 4-valved, with two layers of cells, the outer with nodular thickenings, the inner with indistinct semi-annular thickenings. Elaters long, attenuate, unispiral, the spiral band broad, reddish-brown. Elater-bearers partly *persistent as erect tufts on the apex of the valves.* ♂ branch inrolled, subglobose, mostly without hairs and with a distinct midrib. Antheridia few, shortly pedicellate, globose. Gemmae discoid to linear.

A genus of upwards of 70 known species. It is at once recognised by the distinct midrib which is sharply defined from the 1-stratose broad wings, and by the more or less numerous hairs on the margin of the latter. The inflorescence branches are very short and arise from the side of the midrib underneath. There is no special involucre, the inrolled branch taking the place of this. The ♀ is hairy, the ♂ generally without hairs, though a few may sometimes be present; there is a midrib on the ♂ branch, appearing as a circular band, the ♀ being without this.

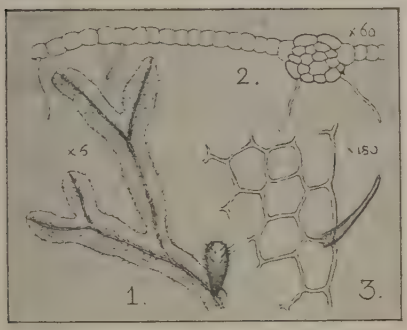
1 { Thallus with hairs on both sides ..... *33. pubescens*
  { Thallus without hairs on the upper side 2

2 { Postical side of midrib mostly 2 cells broad; hairs on margin of thallus geminate, long and curved; dioicous... ..... *32. hamata*
  { Postical side of midrib mostly 4 cells broad 3

3 { Wings frequently with hairs on the underside and with single hairs just within the margin, cells 34–42 μ in diam.; dioicous; gemmae sometimes present *30. furcata*
Wings nearly always without hairs on the underside, hairs on the margin mostly geminate, cells 45–56 μ in diam.; monoicous; gemmae never present *31. conjugata*

30. Metzgeria furcata (L.) Dum.

Jungermannia furcata L., Sp. Pl. p. 1136 (1753).
Metzgeria furcata Dum., Rec. d'Obs. p. 26 (1835).
Metzgeria furcata Lindb., Hep. in Hib. lect. p. 496 (1875).



1. Fertile plant. 2. Section of thallus. 3. Cells.

Dioicous. Plants forming yellow-green or green flat patches. Thallus to 2·5 cm long and ·5–1 mm broad, irregularly branched and furcate, branches short, *flat* or slightly convex, naked above. Antical surface of midrib 2 cells wide and slightly arched, the postical generally 4 cells wide and more highly arched with scattered straight hairs. Wings with more or less *scattered hairs* which extend *to below the margin*, or almost naked, the margin with none or *few and single*. Hairs *straight or flexuose*, some frequently ending in palmate suctorial branches. Cells of wings hexagonal, *34–42* μ in diam., walls thin with slightly thickened angles. Calyptra narrowly pyriform with rather numerous hairs. Pedicel of capsule 1·5–2·5 mm long. Capsule oval-globose, reddish-brown. Spores 21–28 μ in diam., granular-papillate, appearing finely punctate, greenish-yellow to brownish-yellow; elaters 5–7 μ broad, the spiral pale reddish-brown.

var. fruticulosa (Dicks.) Lindb., Monog. Metz. p. 40 (1877).

Riccia fruticulosa Dicks., Pl. Crypt. Fasc. 1 p. 8 (1785).
Jungermannia fruticulosa Sm., Eng. Bot. xxxv *pl.* 2514 (1813).
Jungermannia furcata var. *aeruginosa* Hook., Brit. Jung. *pl.* 55 (1813).
Metzgeria furcata var. *gemmifera* et var. *prolifera* Nees, Eur. Leb. III pp. 488 and 489 (1838).
Metzgeria furcata var. *violacea* Dum., Hep. Eur. p. 139 (1874).
Metzgeria fruticulosa (Dicks.) Evans in Ann. Bot. p. 296 (1910).

Small, yellowish-green but *becoming bluish-green when dried*, thallus more furcate towards the extremities, some branches prostrate or ascending with broad apex, convex, with a few oblong gemmae from the margin and midrib, *other branches suberect, more elongate and narrow, strongly convex*, with discoid or oblong gemmae from the margin *and from both surfaces near the apex;* midrib narrow below and generally composed of few cells, *broadened and of many cells on the branches* and occupying sometimes almost the entire thallus of the suberect parts. Occasionally some branches flat, ascending, frequently without a midrib, with discoid or oblong gemmae from the margin. Hairs frequently rather numerous, both on the margin and just within it, also on the wings as well as on the midrib, single, seldom geminate.

var. **ulvula** Nees, Eur. Leb. III p. 489 (1838).

Very small; in flattened *pale yellowish-green cushions;* thallus only slightly furcate, prostrate or nearly so with numerous *suberect, mostly linear gemmae* of varying length and 2–6 cells broad, without a midrib or in the older parts with one present but weakly defined, the gemmae proceeding *from the margin, also with adventive branches of similar appearance from the midrib;* hairs very scarce, almost or entirely absent from the gemmae and adventive branches.

Hab. On trees and rocks, usually in rather dry places.

Distrib. N. to Shetland, very common; Ireland. Fr. Sept.–Feb.

The larger forms of this species are frequently confused with *M. conjugata*. The present species usually grows more closely appressed to and directly on the bark of trees. The thallus is frequently almost entirely naked, except on the midrib where there are always a few hairs, and it is generally flat; the branches vary more in width. ♂ inflorescence often occurs in quantity and is conspicuous, and gemmae are sometimes present. *M. conjugata* is monoicous, most frequent on mosses, or on rocks, seldom directly on the bark of trees; though the thallus is sometimes nearly flat, it is more often distinctly convex above, being frequently almost semicircular in section; hairs are seldom seen on the wings, but are more numerous and more bristle-like on the midrib and margin; those on the margin are mostly in pairs, while in *M. furcata* they usually occur just below the margin instead of on it, and are almost always single. The cells of the wings are larger in *M. conjugata*. The latter species is not found on dry or exposed places and is rarely present below the subalpine region. However, poorly developed plants of the two species cannot always be distinguished.

The gemmiferous state of typical *M. furcata* has oblong to oblong-oval slightly convex gemmae which proceed from the margin, and sometimes a few linear adventive branches from the midrib. There is no definite distinction between these linear branches in this species and gemmae; the former are not always true adventive branches as they sometimes take their rise from a cortical cell of the midrib. Evans has gone minutely into this subject in the *Annals of Botany* p.p. 271–303 (1910).

The var. *fruticulosa* has been subject to varied treatment since its publication by Dickson. For some years the tendency appears to have been to dismiss

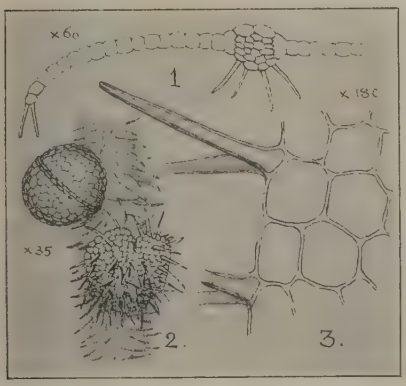
it as of little or no value, but now Evans, in the above paper, has re-instated it as a species. He does this not altogether without doubt, as he considers it possible that it may be an immature state of some other species of the genus, especially *M. conjugata*. I cannot see that it has much relation to that species, and its distribution in Britain is that of *M. furcata* and not at all that of the other.

The var. *fruticulosa* has special, modified gemmiferous branches, but all stages can be seen between these erect, narrow ones and the broad branches. Marginal gemmae may appear on branches which become modified, but those branches which become narrow and erect are so generally before they become gemmiferous.

In the var. *ulvula* the gemmae are flat at first, but generally show at an early stage a slight convexity of the dorsal surface. Here also there is no line of demarcation between the gemmae and the adventive branches, or between either of them and a thallus. This variety does not have special modified gemmiferous branches nor does it ever turn blue in colour. The midrib on the old thallus is frequently only two cells broad postically.

✓31. Metzgeria conjugata Lindb.

Jungermannia furcata var. *elongata* Hook., Brit. Jung. *pl.* 55 and 56? (1813). *Metzgeria conjugata* Lindb., Hep. in Hib. lect. p. 495 (1875).



1. Section of thallus. 2. Monoicous inflorescence. 3. Cells.

Monoicous. Plants forming rather large yellow-green flat patches. Thallus to 3 cm long and 2 mm broad, somewhat translucent, regularly dichotomously branched, branches linear, *convex*, naked above. Antical surface of midrib 2 cells wide and slightly arched, the postical 3–5, *generally 4*, cells wide and more highly arched, with numerous straight hairs. Wings *decurved*, *naked*, or rarely with a few scattered hairs; margin with more or less numerous *straight and divaricate hairs*, *mostly geminate*. Hairs frequently ending in palmate suctorial branches. Cells of wings *45–56* μ in diam. with very slightly thickened angles. Calyptra with numerous bristle-like hairs. Pedicel of capsule about 1·4 mm long; spores 18–23 μ in diam., brownish-yellow. Elaters with a dark red spiral.

HAB. On moist shady rocks, seldom on trees.

DISTRIB. N. to Orkney, frequent in the subalpine region, rare elsewhere; Ireland. Fr. Sept.–May.

When the wings are much decurved the hairs on the margin might at first sight appear as if hamate as in *M. hamata*, but closer inspection shows them to be straight; although usually in pairs, they are not unfrequently ternate or single.

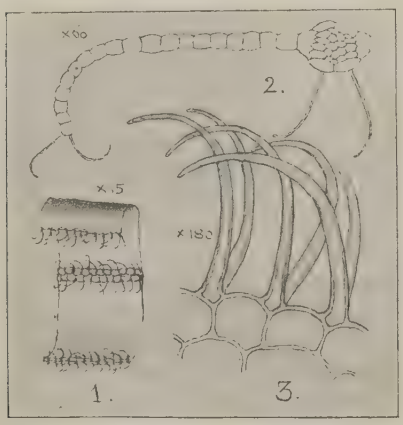
♂ and ♀ inflorescence are very commonly present in *M. conjugata*, so that its distinctive monoicous character can be generally determined without difficulty.

This species occurs in two forms; one being in compact patches, the thallus broad, considerably branched and divaricate-furcate at the apex with the branches short and broad; the other is most commonly found in loose patches or creeping among mosses, the thallus is narrower, usually more convex, slightly or not branched, the branches long and narrow, rarely shortly divaricate at the apex. The latter form is probably Hooker's *Jung. furcata* var. *elongata*, which however may be in part *M. hamata;* plate 56 fig. 2 of his *Brit. Jung.* is more like *M. hamata* than *M. conjugata*. Somewhat analogous forms are to be found in the other species but not so distinctly marked. Even in *M. conjugata* they cannot always be separated.

Goebel states that gemmae occur in this species on erect narrow branches. It is probable that the plant was not correctly identified.

32. Metzgeria hamata Lindb.

Metzgeria linearis Lindb. (non *M. linearis* (Sw.) Aust.) Hep. in Hib. lect. p. 494 (1875).
Metzgeria hamata Lindb., Monogr. Metz, p. 25 (1877).



1. Portion of thallus. 2. Section of do. 3. Cells.

Dioicous. Plants forming large extensive patches on wet rocks or thin layers on mosses, pale green or yellow-green, or bright green on very dry ground. Thallus *elongate*, to 6 cm long and 2·5 mm broad, laxly and irregularly dichotomously branched, *strongly convex* above. Midrib *almost equally* arched on both surfaces, *each composed of 2 cells;* hairs on the postical side in two rows, *long and incurved or hamate*. Wings *naked*, greatly decurved and *almost connivent*, the margins with long divaricate and *hamate hairs in pairs;* cells of wings 42–63 μ

in diam., walls thin, angles very slightly thickened. ♀ branch broadly rotund-ovate with long and mostly single straight hairs on the margins.

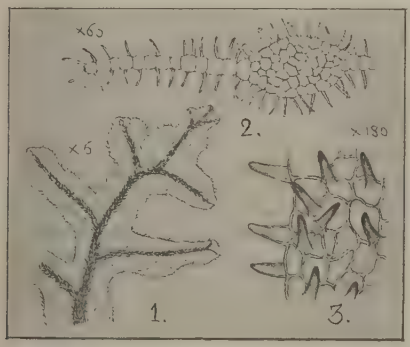
HAB. On wet rocks in well sheltered ground.

DISTRIB. From Worcester? and Wales to Orkney, almost confined to the west side of the country; Ireland. Sterile.

This atlantic species is confined to moist sheltered ground. In ravines it occasionally forms cushions of 2-3 ft. in diam. on wet rocks, and in this condition it bears no resemblance to our other species. When scattered over mosses, it might be mistaken in the field for *M. conjugata*, but the narrow 2-celled postical surface of the midrib, and the hamate hairs on the margin, make it readily recognizable with a pocket lens. When dry the wings are so greatly decurved as to form almost a tube. ♀ inflorescence is rather common in this country. I have not seen gemmae.

33. Metzgeria pubescens (Schrank) Raddi

Jungermannia pubescens Schrank, Prim. Fl. Salisb. p. 231 (1792).
Metzgeria pubescens Raddi in Att. soc. scient. Mod. 18 p. 46 (1818).



1. Portion of thallus. 2. Section of do. 3. Cells.

Dioicous. Plants forming rather large patches on rocks or thin layers on mosses, *grey-green* or yellow-green, not shining. Thallus to 3 cm long and 2 mm broad, irregularly *pinnate*, undulate, not convex above, the branches frequently very gradually attenuate to an obtuse apex, *thickly beset on both surfaces* with pointed, straight or slightly bent hairs, those on the margin frequently in pairs or ternate. Midrib subterete, highly and almost equally arched on both surfaces which are *8–10* cells in width, the epidermal cells *hardly larger* than the internal cells. Cells of wings 5–6-angled, not elongate, 32–42 μ in diam., walls thin, angles hardly thickened. ♀ branch with hairs on both surfaces. ♂ branch with hairs only on the postical surface.

HAB. On shaded rocks, chiefly calcareous.

DISTRIB. From Stafford and York to Caithness, uncommon; Ireland. Sterile.

The hairs on the antical surface of the thallus at once separate this species from the others. The structure of the midrib is different, being composed of many nearly uniform cells, while in our other species the epidermal cells are few, and are larger than the internal ones.

SUBFAMILY Dilaenoideae

Dilaeneae Dum.; *Diplolaeneae* Dum.; *Diplomitrieae* Nees; *Leptotheceae* Spruce; *Leptotheceae* Schiffn.; *Blyttiaceae* Cavers.

Thallus with a distinct and usually sharply defined midrib, ♂ and ♀ inflorescence *on the dorsal surface of the thallus*, not on special branches, the archegonia in groups. *Involucre double* (in the European genera) or single. Capsule generally *cylindrical*, never spherical, usually dehiscing incompletely by 2–4 valves, the inner wall *without semi-annular thickenings.*

XIII. PALLAVICINIA S. F. Gray

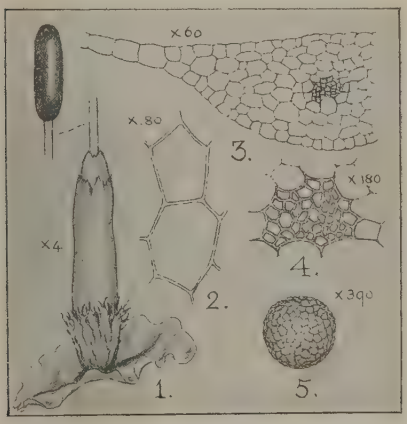
Pallavicinius S. F. Gray, Nat. Arr. Brit. Pl. 1 p. 775 (1821).
Dilaena Dum., Comm. Bot. p. 114 (1822).
Blyttia Endl., Gen. Pl. p. 1339 (1840).

Thallus prostrate and creeping throughout, or with a creeping cylindrical basal, and an erect fan-shaped portion; the margin entire or bearing incipient leaf-appendages; simple, seldom furcate, sometimes with ventral innovations, always *with a distinct midrib* and a lamina one cell thick for the greater part. Midrib with a *central strand of narrow elongated thickened cells. Underleaves absent.* Inflorescence on the *dorsal surface of the midrib.* Archegonia in groups surrounded by laciniate outgrowths coherent at the base and *forming an involucre*, followed during the maturing of the sporogonium by a tubular inner sheath *forming the pseudoperianth.* Calyptra fleshy at the base. Capsule oblong-*cylindrical*, of *two layers* of cells, without semi-annular thickenings, dehiscing *incompletely* by 2–4 valves, the valves usually cohering at the apex. Elaters 2–3-spiral. Antheridia on separate plants, solitary, globose, shortly pedicellate, almost always biseriate on the midrib, covered by variously dentate scales arching towards the apex of the thallus.

This genus comprises about 30 species, nearly all exotic. At the apex of the capsule there is a growth of tissue which binds the valves together, causing these to be nearly always coherent at that point.

34. Pallavicinia Lyellii (Hook.) Gray

Jungermannia Lyellii Hook., Brit. Jung. *pl.* 77 (1816).
Pallavicinius Lyellii Gray., Nat. Arr. Brit. Pl. 1 p. 775 (1821).
Dilaena Lyellii Dum., Comm. Bot. p. 114 (1822).
Blyttia Lyellii G. L. N., Syn. Hep. p. 475 (1846).



1. Portion of fertile plant. 2. Cells. 3. Section of thallus. 4. Central portion enlarged. 5. Spore.

Dioicous. In thin pale green patches. Thallus 3–4 cm long and to 4 mm broad, tender, simple or innovating from postical side of midrib, more rarely furcate, margins usually undulate. Midrib flat above, almost semicircular below, 12-14 cells thick in the middle, suddenly passing into the lamina, with a *central strand of narrow lignified cells*; cells of lamina 5–6-angled, elongated and rectangular at the margin, walls thin. Rhizoids pale brownish, somewhat numerous from the midrib; *underleaves absent*. ♀ inflorescence from about the middle of the thallus; involucre short, *shortly and unequally laciniate*; pseudoperianth 5–7 mm long, 2 cells thick above, 2–3 cells thick below, cylindrical, mouth ciliate. Calyptra *as long as, or slightly longer* than the pseudoperianth, *3–4 cells thick above*, 4–5 cells thick below. Capsule cylindrical, reddish-brown, 4 mm long; pedicel 3–3·5 cm long; capsule-wall of *two layers* of cells, but only one when mature, the radial walls thickened. Spores 21–24 μ in diam., reddish-brown, finely reticulate, the margin appearing as if slightly papillose. Elaters hardly attenuate, reddish-brown. ♂ plant smaller, antheridia in one row on each side of the midrib, scales roundish-ovate, shortly laciniate, somewhat distant or imbricate, monandrous.

Hab. In boggy ground and among wet rocks on the low ground.

Distrib. From Westmoreland southward, rare; Ireland.

This species bears some resemblance to narrow states of *Pellia*, but it may nearly always be distinguished in the field by its paler green colour and more tender and wavy appearance, and by the bracts on the dorsal surface. It may at once be known by making a section of the thallus, as in *Pallavicinia*, besides its central strand, the wings are for the most part only one cell thick, while in *Pellia* they are several cells thick except just at the margin. The central strand can also be seen under the microscope on a surface view.

XIV. MOERCKIA Gottsche

Moerckia Gottsche in G. and R. Hep. Eur. Exs. no. 121 (1860).
Pallavicinius S. F. Gray, Nat. Arr. Brit. Pl. 1 p. 775 (1821).
Dilaena Dum., Comm. Bot. p. 114 (1822).
Calycularia Steph., Spec. Hep. I p. 355 (1900).

Thallus always prostrate and creeping; the frequently wavy margin never with leaf-appendages. *Midrib without a central strand* of narrow, thickened cells, but sometimes with two less developed lateral strands. *Underleaves filamentous*, of a single series of cells on each side of the midrib, evanescent. Inflorescence as in *Pallavicinia*. Involucre sometimes only lobed. *Calyptra tender above, shorter than the cylindrical pseudoperianth. Capsule cylindrical-ovate*, dehiscing incompletely by 2–4 valves, the valves rarely cohering at the apex, *the walls of 3–6 layers of cells* without semi-annular thickenings. Elaters bispiral. Antheridia on separate plants, solitary or in pairs, usually biseriate on the midrib, covered by scales which frequently coalesce to form chambers.

This genus has usually been included in *Pallavicinia* in this country. It is more generally kept distinct on the Continent. It differs from the other in several characters, notably in the presence of underleaves, the different structure of the capsule-wall, and the absence of the central strand of thickened cells.

The filamentose underleaves are composed of a single series of cells, or occasionally partly of a double series, tipped with a club-shaped papilla. They are most numerous near the growing point at the apex of the thallus.

The pseudoperianth is always much longer than the involucre.

The single layer of cells of the outer wall of the capsule is as thick as the combined layers of the inner walls. Judging from the small available material which I have seen of *M. hibernica*, the inner layers appear to be more disorganised and fewer in number than in *M. Flotowiana* or *M. Blyttii*.

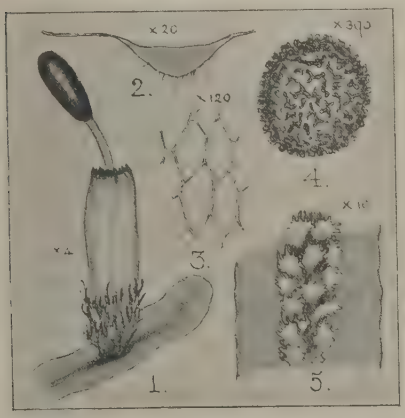
The structure of the spores is similar in all the species, the lamellae being more or less interrupted or forming a network. In profile these ridges have the appearance on the margins of blunt teeth, varying from being coarsely papillose in *M. Flotowiana* and *M. hibernica* to having large comb-like teeth in *M. Blyttii*.

1 { Rhizoids reddish-brown; involucre with broad lobes; on high alpine banks ..... *37. Blyttii*
  { Rhizoids white, occasionally yellowish; involucre deeply laciniate; usually on the low ground 2

2 { Thallus rather thick, usually with greatly crisped margins; midrib 15-20 cells thick in the middle; spores 45–49 μ in diam. ..... *36. Flotowiana*
  { Thallus tender, without crisped margins; midrib 10–14 cells thick in the middle; spores 35–43 μ in diam. ..... *35. hibernica*

35. Moerckia hibernica (Hook.) Gottsche

Jungermannia hibernica Hook., Brit. Jung. *pl.* 78 et Suppl. *pl.* 4 (1816).
Dilaena hibernica Dum., Comm. Bot. p. 114 (1822).
Moerckia hibernica var. a *Hookeriana* Gottsche in G. and R., Hep. Eur. Exs. no. 121 (1860).
Pallavicinia Flotowii var. *β hibernica* Lindb., Musc. Scand. p. 10 (1879).
Calycularia hibernica Steph., Spec. Hep. I p. 359 (1900).



1. Portion of fertile plant. 2. Section of thallus. 3. Cells. 4. Spore. 5. Male inflorescence.

Dioicous. In thin pale green patches. Thallus to 3·5 cm long and to 4 mm broad, *tender*, furcate, margin *slightly* undulate. Midrib, with somewhat numerous white rhizoids, *triangular in section but rounded below, 10–14 cells thick* in the middle, rather suddenly passing into the lamina; cells of lamina 4–6-angled, elongated at the midrib, walls thin. ♀ inflorescence from about the middle of the thallus; involucre *deeply laciniate, laciniae dentate*; pseudoperianth 4–5 mm long, cylindrical, narrowed below, mouth dentate. Calyptra shorter than the pseudoperianth. Capsule oblong-ovate, reddish-brown, 2·5 mm long; pedicel to 4 cm long; capsule-wall of 4, occasionally 3, layers of cells, the cells of the outer layer large with the radial walls thickened, those of the inner layers much smaller with the radial walls less thickened. Spores *35–43* μ in diam., reddish-brown with short, irregular ridges, sometimes forming reticulations, the margin appearing as if coarsely papillose. Elaters reddish-brown, attenuate, with a few shorter and broader, also bispiral, which are loosely attached to the capsule-wall. ♂

plant smaller, antheridia in rows on the midrib, scales ovate, dentate, 1–2-androus.

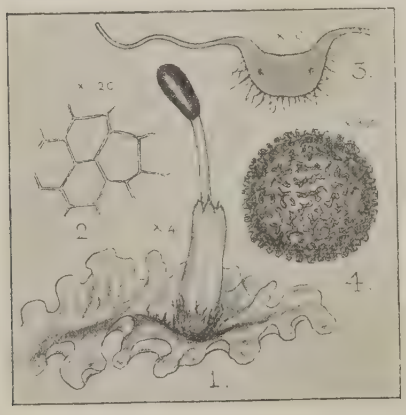
HAB. In marshy ground.

DISTRIB. Forfar, Shetland, very rare; Ireland.

In this rare species, the thallus is thin and very little undulate. The rhizoids are white and the ridges on the spores seldom form reticulations. In habit it resembles *P. Lyellii*, from which it may without difficulty be separated by the absence of the central strand of narrow cells.

36. Moerckia Flotowiana (Nees) Schiffn.

Cordaea Flotowiana Nees in Diar. Bot. Ratisb. II p. 401 (1833).
Diplolaena Lyellii β *Flotowiana* Nees, Eur. Leb. III p. 344 (1838).
Moerckia hibernica var. *Wilsoniana* Gottsche in G. and R., Hep. Eur. Exs. no. 121 (1860).
Pallavicinia Flotowii Lindb., Musc. Scand. p. 10 (1879).
Moerckia Flotowiana Schiffn., Oest. Bot. Zeit. no. 2 (1901).



1. Portion of fertile plant. 2. Cells. 3. Section of thallus. 4. Spore.

Dioicous. In small bright green or yellow-green, *strongly odorous* patches. Thallus 1–2·5 cm long and 3–5 mm broad, rather thick, furcate, margin incurved, undulate and usually *greatly crisped*. Midrib highly prominent below, with numerous *white* or pale yellow rhizoids, *trapezoid in section, 15–20 cells thick* in the middle, rather gradually passing into the lamina, with generally *two lateral strands* of narrow, usually lignified cells. ♀ involucre short, *irregularly laciniate*; pseudoperianth to 5 mm long, 1 cell thick in the upper part, 3–4 cells thick at the base, cylindrical, mouth lobed and ciliate, frequently reddish-brown. Calyptra shorter than the pseudoperianth, 1 cell thick above, 4–5 cells thick at the base. Capsule cylindrical-oval, reddish-brown, 3 mm long; pedicel to 3 cm long; capsule-wall of 5 layers of cells with the radial walls thickened and reddish, those of the outer layer large, of the inner layers much smaller and delicate. Spores 42–49 μ in diam., reddish-brown, with ridges

frequently forming reticulations, the margin appearing as if coarsely papillose. Elaters of the same colour, attenuate, with a few shorter and broader, also bispiral, which are loosely attached to the capsule-wall. Antheridia numerous on the midrib, scales ovate, irregularly dentate, monandrous.

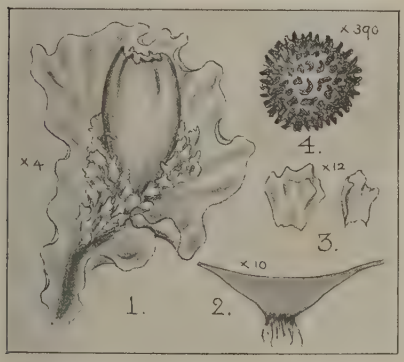
HAB. On moist sandy ground near the sea, occasionally in marshy ground inland.

DISTRIB. From Forfar southwards, uncommon; Ireland. Fr. May-Aug.

This species is strongly odorous. There are frequently several pseudo-perianths close together on the thallus. It is closely allied to *M. hibernica*, differing principally in the shape, and in the number of cells, of the midrib, the greatly crisped margin of the lamina and in the spores. Cavers has shown that when plants of this species are cultivated in a constantly moist condition, the lateral strands are absent in the new branches. The strands appear always to be present in the plant of the usual habitat in Britain, viz., damp sandy ground, but in wetter places they may sometimes be absent. It is a brittle plant like *M. Blyttii*, which it also resembles in habit. It does not resemble any other species which is found in sand-dunes, but when in wet inland and somewhat elevated localities it is less crisped, and might be mistaken in the field for *M. hibernica*.

37. **Moerckia Blyttii** (Moerch) Brockm.

Jungermannia Blyttii Moerch, Fl. Dan. 12 p. 6 *pl.* 2004 (1830).
Diplolaena Blyttii Nees, Eur. Leb. III p. 339 (1838).
Moerckia norvegica Gottsche in Gott. et Rabh., Hep. Eur. Exs. no. 121 (1860).
Moerckia Blyttii Brockm., Arch. Ver. Freunde Nat. Mecklen. 17 p. 190 (1863).
Dilaena Blyttii Dum., Hep. Eur. p. 138 (1874).
Pallavicinia Blyttii Lindb., Musc. Scand. p. 10 (1879).
Calycularia Blyttii Steph., Spec. Hep. I p. 36_0 (1900).



1. Fertile plant. 2. Section of thallus. 3. Involucral bracts. 4. Spore.

Dioicous. In rather extended yellowish-green patches. Thallus to 2 cm long and 8 mm broad, rather thick, simple or furcate, margin ascending, *undulate and crisped*. Midrib highly prominent below, with numerous *reddish*-brown rhizoids, 20–25 cells thick in the middle, gradually passing into the lamina. ♀ involucral bracts connected at the base, otherwise free, *short and broad*, spathulate or irregularly shaped, variously dentate. Pseudoperianth

to 5 mm long, 2 cells thick above, 4–5 cells thick below, *campanulate*, slightly *plicate* at the apex, mouth unequally lobed, the lobes incurved, with a few broad teeth. Calyptra thick below, shorter than the pseudoperianth. Capsule cylindrical-ovate, reddish-brown, 3–4 mm long; pedicel 1–2 cm long; capsule-wall of 5 layers of cells, with the radial walls thickened and reddish, those of the outer layer large, of the inner layers much smaller and delicate. Spores 33–42 μ in diam., reddish-brown, with short, curved, irregular ridges, the margin appearing as if with *long, flattened teeth*. ♂ inflorescence near the apex of the thallus, scales plicate, *roundish to obovate, frequently 2–3 lobed*, monandrous.

Hab. On moist soil, rarely in wet ground, on the higher mountains of the Highlands from 3100–3800 ft. alt.

Distrib. Perth to Rosshire, rare. Fr. July–August.

This is the only species of the genus which is found on bare soil at high elevations. There is no plant in this habitat in any way resembling it except *Pellia epiphylla*, but it is readily distinguished from that species by the presence of the lobed bracts which are almost constantly present throughout Summer. It fruits much later in the year than *Pellia*, the capsule is of a different shape and colour, and the rhizoids are golden-yellow to reddish-yellow.

The unistratose margin of the lamina is comparatively narrower than in the other species of the genus. It is a very brittle plant and has scale-like leaves on the dorsal surface as well as bracts.

The ♀ bracts are free except just at the base where they form an annulus. They vary greatly in shape, but are short and broad and do not resemble those of the other species. The rhizoids are also much deeper yellow than in the others.

Subfamily Codonioideae

Thallose, foliose, or forms intermediate between them. In the foliose forms the leaves are in two rows, parallel to the stem or obliquely inserted and succubous, simple (never bilobed). Rhizoids always present. ♂ and ♀ inflorescence scattered, or in groups, on the dorsal surface. ♀ *involucre single* (in the European genera), rarely double. Capsule usually longly pedicellate, *globose* (oval in *Blasia*), dehiscing to the base by 4 valves or irregularly, the wall of two or more layers of cells, the inner *nearly always with semi-annular thickenings*. Elaters adherent *to the base of the capsule* or partly free, more rarely altogether free, 2–4-spiral.

This subfamily includes the *Haplolaeneae* of Nees, comprising the genera

Pellia and *Blasia* but excluding *Symphyogyna*, and the *Codonieae* of Dumortier comprising the genera *Fossombronia* and *Codonia* (Petalophyllum).

XV. PELLIA Raddi

Marsilia Mich., Nov. Pl. Gen. p. 5 (1729).
Jungermannia L., Fl. Suec. ed. 1 p. 339 (1745).
Pellia Raddi, Mem. Soc. Ital. Mod. 18 p. 49 (1820).

Thallus somewhat fleshy, undulate at the margin, irregularly dichotomously branched, with a broad, mostly indistinct midrib passing gradually into the 1-celled margin; rhizoids numerous from the midrib; ventral scales absent. Archegonia in groups of 4–12 in a *pocket-like cavity* on the *dorsal surface* of the thallus, covered by an involucre opening in front or forming a tubular sheath. Calyptra included or exserted. Capsule longly pedicellate, *spherical*, the wall with two or more layers of cells, dehiscing almost to the base into 4 valves. Elater-bearers 20–100 in number, *attached to the base of the capsule;* elaters 2–3-spiral. Spores *very large*, *multicellular*. Antheridia shortly pedicellate, *immersed*, usually singly, on the *dorsal surface of the midrib*. Gemmae absent.

This genus comprises the three following species, widely spread in the northern countries of Europe, Asia and America. *P. epiphylla* is one of our commonest hepatics, except in calcareous districts; its numerous capsules on thin long hyaline pedicels are a conspicuous feature in Spring in most districts.

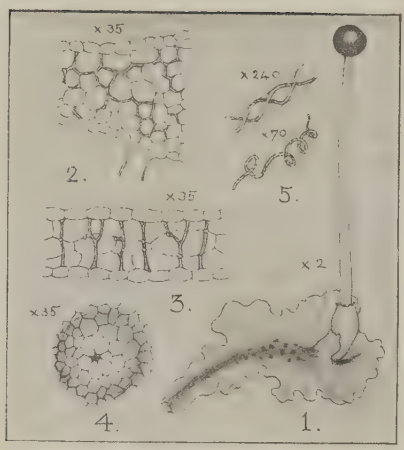
1 { Thallus with brown thickened bands on section; calyptra exserted; inner wall of capsule with numerous semi-annular thickenings 2
  { Thallus without thickend bands; calyptra included; inner wall of capsule without semi-annular thickenings ..... *40. Fabbroniana*

2 { Margin of involucre absent on the side towards apex of thallus; paroicous ..... *38. epiphylla*
  { Involucre forming a complete ring, mouth erect; dioicous ..... *39. Neesiana*

38. Pellia epiphylla (L.) Corda

Jungermannia epiphylla L., Sp. Pl. p. 1135 (1753).
Pellia epiphylla Corda in Opiz, Beitr. p. 654 (1129).

Paroicous. In extended flat patches, dark green with frequently a reddish tinge. Thallus to about 10 mm broad, expanded at the lobed and cuneate or obovate apex; in section 11–15 cells thick in the middle with interlacing *thickened bands* in the



1. Plant showing paroicous inflorescence.
2. Transverse section of thallus.
3. Longitudinal section. 4. Male tubercle.
5. Elater, with portion more magnified.

walls. Involucre reduced to a semi-cylindrical *scale-like flap* on the posterior side of the cavity from which the calyptra arises, *incised* at the free margin. Calyptra *much exserted*, arcuate, cylindrical-clavate, roughened with scattered 2-celled hairs, rosy coloured at the base and frequently also towards the apex. Capsule globose, dark olive-green, of 2–3 layers of cells; pedicel hyaline to 5 cm long. Outer layer of capsule-wall with hexagonal cells having nodular thickenings, inner layer with elongated cells having *numerous semi-annular thickenings*. *Elaters very long and thin*, contorted, 8 μ broad, mostly bispiral; elater-bearers thick, 20–30 in number, 3–4-spiral. Spores 80–100 μ in diam., oblong-oval, muriculate, yellow-green. *Antheridia behind the* ♀ *inflorescence*, beneath small, reddish elevated tubercles.

var. **undulata** Nees, Eur. Leb. III p. 365 (1838).

Rather densely caespitose. Thallus 3–5·5 cm long, *erect or suberect*, somewhat membranous, in two forms (1) *broadly ligulate*, to 8 mm broad, slightly furcate, the apex obtuse but hardly expanded, *margin undulate-lobate*, (2) *narrowly linear-lanceolate*, to 4 mm broad, simple, tender, flat, *the margin entire*.

Hab. On moist banks, ditches and among wet rocks.

Distrib. N. to Shetland, very common; Ireland. Fr. Feb.–May.

This is the only species of the genus which is found on moist loamy banks. It there fruits abundantly in Spring, but can at all times be known in this habitat by the large patches with the younger parts pale green. The paroicous inflorescence can be detected throughout a great part of the year, but the proterandrous character of the species, as with other hepatics, might make it appear in certain states as if dioicous.

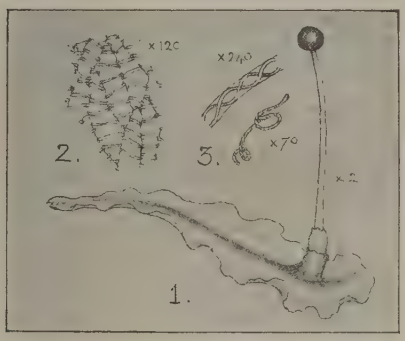
Aquatic forms of this and the other two species are sterile, but involucres can nearly always be found on some of the stems, and by these the present plant

can be separated from the others. This incomplete involucre can also be found on the land forms of *P. epiphylla* during a great part of the year.

The brown thickened fibrous bands in the midrib of this species and of *P. Neesiana* will separate sterile plants from *P. Fabbroniana*. These bands run vertically and transversely, so that in a longitudinal section the vertical fibres are most in evidence, also the cut ends of the horizontal ones can be seen, while in a transverse section the bands are short and run both vertically and transversely. They can most readily be seen in a longitudinal section. Mr. Jameson points out to me that these bands strongly affect polarized light, and may indeed thus be detected even in the entire thallus, without dissection.

39. **Pellia Neesiana** (Gottsche) Limpr.

Pellia epiphylla forma *Neesiana* Gottsche in Hedwigia p. 69 (1867).
Pellia Neesiana Limpr., Krypt. Fl. Schles. p. 329 (1876).



1. Fertile plant. 2. Inner wall of capsule. 3. Elater, with portion more magnified.

Dioicous. In less extended patches than *P. epiphylla*, nearly always tinged with dark red, especially on the midrib, translucent towards the margin. Thallus rather narrower, more undulate and of more equal width, less expanded and usually less lobed at the apex; in section about 12 cells thick in the middle with interlacing *thickened bands*. Involucre forming *a short complete cylinder*, or occasionally split on the antical side, irregularly *crenate lobulate* at the mouth. Calyptra more or less *exserted*, seldom included, cylindrical with expanded apex, roughened with 2-celled scattered hairs. Capsule, spores and elaters as in *P. epiphylla*. ♂ plant generally growing with the ♀.

var. **undulata** Jack in Flora Bot. 81 p. 15 (1895).

Rather densely caespitose. Thallus 4–7 cm long and 3–8 mm broad, *erect or suberect*, somewhat membranous, broadly linear, narrow at the base, the apex obtuse but hardly expanded, *flat with the margins undulate-lobate*, simple, or slightly furcate especially from below the middle, the midrib distinct; rhizoids scarce towards the apex.

Hab. In wet grassy ground.

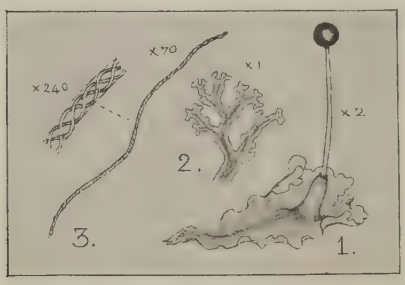
Distrib. N. to Shetland, rare in the south; Ireland. Fr. April–June.

The involucre is frequently split on one or both sides on the egress of the capsule, thus separating the antical half as a small rim. The capsule is rather lighter in colour than in *P. epiphylla*. The thallus has considerable resemblance to that of *P. Fabbroniana*, but is rather broader, less channelled, generally tinged with dark red, and apical furcate innovations are never present, though the midrib is often conspicuous. When on the low ground it usually occurs in wet grassy places, while *P. Fabbroniana* more frequently forms compact patches about the base of wet rocks. The thickened bands on the midrib of *P. Neesiana* will always separate sterile plants from that species. The complete ring of the involucre can be seen for a considerable part of the year and this will separate the plant from *P. epiphylla* apart from the dioicous inflorescence.

The usually present reddish tinge of the var. *undulata* of this species and of *P. epiphylla* separate them in the field from the dark green var. *lorea* of *P. Fabbroniana*. The two former varieties have their characters best marked when at the sides of alpine rills where they are frequently submerged, but they are probably not more fundamentally distinct than the low ground plants, which are merely forms taken by the typical plants when in very wet ground. The var. *lorea* appears to be somewhat more distinct.

40. Pellia Fabbroniana Raddi

Jungermannia endiviaefolia Dicks., Pl. Crypt. Fasc. IV p. 19 (1801).
Jungermannia epiphylla β *longifolia* et γ *furcigera* Hook., Brit. Jung. *pl.* 47 (1813).
Pellia Fabbroniana Raddi, Mem. Soc. Ital. Scient. Modena 18 p. 49 *pl.* 7 *f.* 5 (1818).
Jungermannia calycina Tayl. in Mackay, Fl. Hib. p. 55 (1836).
Pellia calycina Nees, Eur. Leb. III p. 386 (1838).
Pellia endiviaefolia Dum., Rec. d'Obs. p. 27 (1835).



1. Fertile frond. 2. Portion of autumnal frond-form. 3. Elater, with portion more magnified.

Dioicous. Thallus narrower than in other species and more branched, 4–7 mm broad, generally with elevated margins, channelled in the centre above the conspicuous midrib, *dark green*, rarely tinged with reddish-brown; the wings translucent, undulate and sometimes crisped towards the apex; section 8–10 cells thick in the middle, *without thickened bands;* apices of the thallus in both sexes very *frequently repeatedly furcate in autumn and winter*. Involucre nearly erect, *tubular*, to 4 mm long, mouth at first incurved, lobed, the lobes *ciliate or laciniate*. Calyptra *included*, cylindrical with expanded mouth, without hairs.

Outer layer of capsule-wall with nodular thickenings at the angles, innermost layer *without semi-annular thickenings*. Elaters *vermiform, not or hardly contorted*, 10–12 μ broad, 3–4 spiral. Elater-bearers very *long and slender*, to *upwards of 100* in number, bispiral. Spores 56–77 μ in diam. ♂ plant linear, generally in separate patches.

var. **lorea** Nees, loc. cit. p. 366 sub. *Pellia epiphylla*.

Densely caespitose. Thallus 4–6 cm long and *3–5 mm broad*, *erect*, *rigid* and brittle, usually considerably and irregularly branched, the branches long with a few short branches intermixed, the terminal segments long and sometimes inflexed at the apex, with the midrib narrow but conspicuous, *rhizoids scarce* on the upper segments and frequently almost absent.

Hab. Near the bottom of wet, shady rocks and at the side of springs, especially in calcareous districts. Var. *lorea* in springs, ditches, rills and among very wet dripping rocks.

Distrib. N. to Orkney, rather common; Ireland. Fr. Feb.–April.

The absence of bands in the thallus will separate sterile plants from the other species of the genus. When in fruit, the different structure of the innermost layer of the capsule-wall is an easily observed character; sometimes a few rudimentary semi-annular rings are to be seen. The furcate apices of the thallus form a conspicuous character in Autumn and Winter. The plant in this condition is the var. *furcigera* Hook. of *P. epiphylla*. The furcate branchlets are very brittle and fall off, the detached pieces forming new plants. They occur on fertile plants, as well as on sterile and on male plants, though they are most frequent on the latter.

The dense erect tufts of the var. *lorea* give it a distinct appearance in its most characteristic state. The stem is often once furcate at the apex, but the branches are long and with a narrow midrib and not repeatedly furcate as in the form *furcigera*. This species has also a form, analogous to the var. *undulata* of the others, with the thallus 4–8 cm long, simple or nearly so, channelled above the midrib, the margins flat or slightly undulate; I include this form here, with some hesitation, under the var. *lorea*.

XVI. BLASIA L.

Blasia Mich., Nov. Pl. Gen. p. 14 (1729).
Blasia L., Sp. Pl. p. 1138 (1753).
Jungermannia Hook., Brit. Jung. *pl.* 82–84 (1816).

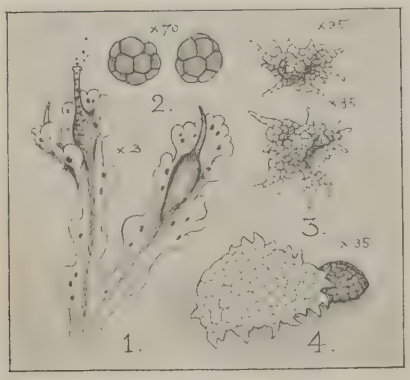
Thallus several times dichotomously branched, with a broad midrib passing into *unistratose* lobes (side leaves). *Underleaves* in one row on each side of the midrib, and *leaf-auricles present* at the base of the lobes. ♀ and ♂ inflorescence on the dorsal surface of the thallus. Archegonia at first naked, one of them on fertilisation

becoming immersed and covered by a *fusiform involucre* with a *constricted mamillate apex*. Calyptra free, thin and membranous. Capsule rather longly pedicellate, *oval, with a collar at the base* to which it dehisces by 4, more rarely 5–6 valves; capsule-wall of 3–4 layers of cells, those of the outer layer with the radial walls nodulose; those of the inner layers smaller and tender without semi-annular thickenings and becoming soon disorganised. Spores 1-celled. Elaters bispiral, the spires often splitting. Elater-bearers few and rudimentary, at the bottom of the capsule. ♂ plant smaller; antheridia few, oval, with a short pedicel, immersed singly in small alveoli. Gemmae of two kinds.

Blasia is in several respects intermediate between the thallose and foliose species. The lobes are horizontally inserted lateral leaves, which however are not sharply separated from the middle portion of the axis: they have a definite position in relation to the axis, arising from the apical cell in the same way as do the leaves of *Fossombronia*; leaf-auricles and underleaves are also present, the latter being placed singly at the junction of the lobe and the axis.

41. Blasia pusilla L.

Blasia pusilla L., loc. cit.
Jungermannia Blasia Hook., loc. cit.



1. Plant with flask-shaped receptacles. 2. Gemmae from do. 3. Stellate gemmae. 4. Underleaf and auricle.

Dioicous. In green or yellow-green rosettes, sometimes forming extended layers. Thallus 1·5–2·5 cm long and 3–5 mm broad, repeatedly branched, with several rounded lobes (leaves), the margin ascending and frequently crisped at the apex of the branches. Midrib broad and flat below, 8–12 cells thick in the middle, gradually passing into the lobes, the marginal row of cells smaller, crenulate; rhizoids numerous from the midrib, white; *underleaves ovate, dentate*. Leaf-auricles generally two at the base of each lobe, spherical, hollow, becoming filled with *Nostoc* colonies and *appearing as black points through the thallus*. Pedicel of capsule to 2 cm long. Spores

33–43 μ in diam., rounded-tetrahedral, yellowish-brown, granulate. Elaters paler in colour. Gemmae of two kinds; one being round or oval, compressed, longly pedicellate and many celled, in *flask-shaped receptacles with long necks* situated in the dorsal side of the midrib; the other occurring as *loose stellate scales* on the dorsal surface near the apices of the thallus.

HAB. On moist gravelly or clayey ground, especially about roadsides and drains and wet banks.

DISTRIB. N. to Shetland, uncommon in general; Ireland. Fr. Feb.–April, rare.

Can be recognised by the black spots on the thallus,—but must not be confused on this account with *Anthoceros*,—by the frequent presence of a white line, caused by a deposit of oxalate of lime, along the midrib and its branches, and by the stellate scales on the dorsal surface near the apex of the lobes. The flask-shaped gemmiferous receptacles, though frequent, are less common, especially in the north; they are distinctive, but must not be mistaken for female involucres. A few underleaves can usually be found without difficulty. The plant more resembles in the field small states of *Pellia epiphylla* than any other species. Mucilage-papillae occur at the apex of the thallus on both the dorsal and ventral surfaces, on the underleaves, in the interior and at the aperture of leaf-auricles, and in the flask-shaped gemmiferous receptacles. It is by the swelling of the mucilage in the latter that the gemmae are expelled.

The leaf-auricles are hollow, nearly round bodies, formed by the rising and then incurving of a plate of cells, which become filled with a colony of *Nostoc* and other *Cyanophyceae*. The effect of the relationship between these and the host is not yet known.

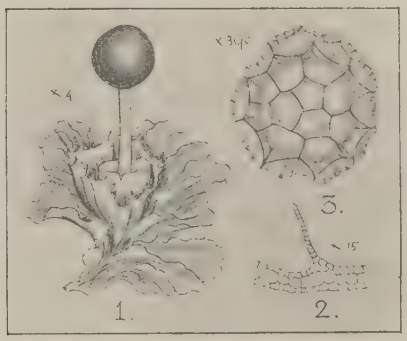
XVII. PETALOPHYLLUM Gottsche

Codonia Dum., Comm. Bot. p. 111 (1822).
Petalophyllum Gottsche in Lehm. Pug. Pl. viii p. 29 (1844).

Plant small and tender with a short basal cylindrical stalk-like portion and a *fan-like expansion*, simple or furcate, with *parallel erect leaf-appendages forming lamellae on the dorsal surface*. Archegonia in groups on both sides of the dorsal surface of the midrib, surrounded by scales within which on fertilisation is formed the tubular pseudo-perianth, the scales being partly carried up on its outer surface as wings. Calyptra free, large. Capsule rather shortly pedicellate, spherical, rupturing irregularly; walls of 3–4 layers of cells, the inner with incomplete annular thickenings. Spores reticulately lamellate. Elaters long, more or less attenuate, 2–3-spiral. ♂ plant separate; antheridia scattered on the dorsal surface, spherical with a short pedicel, covered with a conical or dome-spaced scale.

42 Petalophyllum Ralfsii (Wils.) Gottsche

Diplolaena Lyellii var. *lamellata* Nees, Eur. Leb. III p. 345 (1838).
Jungermannia Ralfsii Wils., Eng. Bot. Suppl. *pl.* 2874 (1843).
Petalophyllum Ralfsii Gottsche in Lehm. Pug. Pl. VIII p. 30 (1844).
Codonia Ralfsii Dum., Hep. Eur. p. 16 (1874).
Petalophyllum lamellatum Lindb., Man. musc. sec. p. 390 (1874).
Fossombronia corbulaeformis Trabut, Atl. Fl. Alger. p. 7 (1886).



1. Fertile plant. 2. Section of thallus through a lamella. 3. Spore.

Dioicous. In small pale green patches. Plant to 10 mm long and to 7 mm broad, the stalk-like portion ascending obliquely through the ground, at first circular in section, becoming, as the midrib, semicircular as it approaches the apex of the *obcordate, or reniform, prostrate portion.* Midrib greatly *prominent below*, rather suddenly passing into the wings which are 3–4 cells thick and ending in a broad, convex, 1-stratose margin; rhizoids rather numerous from the midrib, *white.* Ventral scales in two longitudinal rows at the apical region, triangular, with a few long mucilage hairs Lamellae extending obliquely forwards *from the midrib to near the margin*, undulate, narrowed at each end, of 1 layer of cells, to 15–20 cells high in the middle; cells mostly hexagonal, thin-walled, with numerous chlorophyll granules. Pseudoperianth 3–4 mm long, broadly campanulate, mouth sinuate-lobed and dentate, lobes slightly incurved, the teeth distant, generally broad at base and spinous at the apex with occasionally a few short cilia intermixed; wings irregular in size and shape, part resembling those in *Fossombronia*, with in addition some minute and subulate or variously shaped, others much larger composed of a single series of cells to 12 cells in length or more; the pseudoperianth mostly 1 cell thick, except near origin of wings where it is composed of 2–several layers, sometimes fissured vertically to base on the antical side. Calyptra 1–2 cells thick, at base 3–4 cells thick, slightly shorter than the pseudoperianth, surrounded at base by the sterile archegonia. Capsule 2 mm in diam., spherical, brownish-black, *of 3–4 layers of cells* with numerous chlorophyll granules, outer layer with thin hyaline walls, inner layers with

reddish-brown semi-annular thickenings, opening first by a vertical slit on one side, then rupturing irregularly, sometimes by more or less distinct valves, a small hemispherical portion remaining, having a crenulate margin, and which is little more than a rim around the apex of the pedicel. Pedicel white, pellucid, 8–11 mm, more rarely to 15 mm long. Spores *42–48* μ in diam., spherical, slightly compressed, areolae hexagonal, 10–14 μ in diam., *4–5 across the face of the spore*; margin paler in colour, 6 μ broad, the lamellae forming 13–15, occasionally more, crenulations. Elaters 240–300 μ long and 12–14 μ broad, slightly bent, hardly attenuate, sometimes branched, bispiral, the spires yellow-brown; among these occur a few shorter and broader elaters, to 23 μ in width.

HAB. On the drier and more grassy parts, as well as on the damper sandy parts near the margin of pools on sand-dunes.

DISTRIB. S. of England, Wales, Yorkshire, very rare; Ireland. Fr. April–June.

The lamellae on the dorsal surface distinguish at sight this species from our other hepatics. It may be found at all times of the year, but in exposed localities it is sometimes hidden for weeks by the drifting sand. It is frequently accompanied by *Pallavicinia Flotowiana* and by *Carex arenaria* and *Bryum Warneum*.

This species was originally figured as a variety of *Jung. hibernica* by Wilson in *Eng. Bot. pl.* 2750 fig. 16.

P. Ralfsii consists of a stem which is cylindrical at the base, gradually becoming flattened on the dorsal surface until it forms a broad expansion, on which are vertically situated the obliquely placed leaves in the form of lamellae. These leaves seldom extend over the central part or midrib, they are broadest at the middle and slightly overlap. In the stem are found abundant fungal hyphae. At the apex of the stem near the growing point there are many small scale-like appendages bearing mucilage-papillae as in *Fossombronia*. The archegonia occur in groups between the leaves. The antheridia, which are on separate plants, are scattered along the midrib and are protected by dome-like scales which are sometimes joined together so as to form chambers.

The stem of this species grows from a three-sided apical cell as in the acrogynous *Hepaticae*.

Cavers has described the formation of tubers behind the growing point of the plant. These continue to grow after the disappearance of the more delicate parts and ultimately form new plants.

XVIII. FOSSOMBRONIA Raddi

Fossombronia Raddi in Atti Soc. Ital. Sci. Mod. 18 (1818).

Stem fragile, creeping, simple or dichotomously branched, flattened above and strongly arched below, with long, mostly *violet*

coloured rhizoids attaching the plant firmly to the substratum, the apex ascending. *Leaves in two rows, succubous, very obliquely inserted* and decurrent at the antical base, *more or less quadrate*, generally broader than long, with *irregularly sinuate*, usually *lobed margins*, and towards *the base composed of two or more layers of cells*, otherwise of one layer; cells large, thin-walled, very chlorophyllose. Archegonia on the dorsal surface of the stem near the insertion of the leaves, the fertilized one always near the apex and becoming enclosed in a large *campanulate pseudoperianth*. Pseudoperianth with a *wide, lobed mouth* and narrow base, often longitudinally plicate, and surrounded with subulate scales, and frequently incised to the base on the side towards the apex of the stem. Calyptra tender, pyriform, thick at base. Capsule shortly pedicellate, globose, dehiscing irregularly or imperfectly by four valves; capsule-wall of two layers of cells, the inner layer with frequently incomplete semi-annular thickenings. Spores large, rounded-tetrahedral, *the convex face variously armed*. Elaters short, normally bispiral. Antheridia *orange-yellow, naked*, or partly covered by bracts, on the *antical surface of the stem* near the insertion of the leaves.

All our species have violet rhizoids. The vegetative parts vary greatly and form unsatisfactory features for discriminating between the different species. The shape of the stem varies considerably according to where the section is made. The spores form the only certain means of identification. On the convex face, the exospore, in one group, is arranged in lamellae forming nearly parallel lines, or slightly anastomosing; viewed in profile as they appear on the margin of the spore they look like long papillae or spines, but their structure is clearly seen within the margin or when lying transversely. A second group has the lamellae arranged in hexagonal areolae; these seen in profile on the margin give to the spore a winged or crenulate appearance, according to the height of the lamellae. The third group has the spores papillose or spinous. A high power is necessary to distinguish the various kinds.

1 { Spores furnished with papillae 2
  { Spores with lamellae 3

2 { Papillae 6–8 across the face of spore ..... *45. caespitiformis*
  { Papillae 10–12 across the face of spore ..... *46. Mittenii*

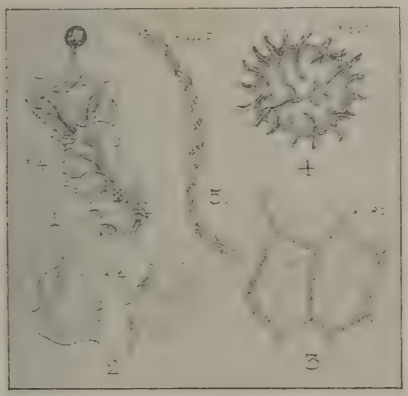
3 { Lamellae in nearly parallel lines 4
  { Lamellae forming alveoli 5

4 { Lamellae on face 15–24 ..... *43. pusilla*
  { Lamellae on face 28–36 ..... *44. Wondraczeki*

5 { Margin of spores appearing as if winged and 10–12-angled ..... *48. angulosa*
  { Margin appearing as if crenulate, not winged, with 16–20 teeth *47. Dumortieri*

43. Fossombronia pusilla (L.) Dum.

Jungermannia pusilla L., Sp. Pl. p. 1136 (1753).
Fossombronia pusilla Dum., Rec. d'observ. p. 11 (1835).



1. Fertile Plant. 2. Leaves. 3. Cells. 4. Spore. 5. Elater.

Paroicous. In small pale green patches, generally larger than *F. Wondraczeki*, odorous. Stems to 13 mm long, simple or furcate, midrib broadly convex postically, flat or slightly convex antically, about three times as broad as high, rather suddenly passing into the 1-stratose lamina. Lower leaves oblong-quadrate, entire or emarginate, sinuous, the upper leaves crowded, broadly reniform, crisped and lobed, lobes obtuse or partly acute. Pseudoperianth 1 75 mm long, campanulate, the mouth crispate or sinuate-lobed, lobes obtuse or sometimes acute. Inner layer of capsule-wall with *many complete semi-annular thickenings*. Spores 36–44 μ in diam., pale reddish-brown, the convex face *with a few slightly sinuous, nearly parallel thick lamellae* which *sometimes slightly* anastomose in the centre, the lamellae appearing in profile on the margin as *16–24 thick spines*. Elaters 7–9 μ broad, 2–3-spiral, pale yellow.

var. **decipiens** Corb., Musc. de la Manche p. 355 (1889).

Spores with lamellae higher, more sinuous, frequently giving the margin partly or wholly a winged appearance, and with a larger amount of anastomosing in the centre.

Hab. On bare, moist soil in cult. fields and banks, footpaths and sides of ditches.

Distrib. N. to Caithness, frequent but rarer in the north; Ireland. Fr. Aug.–April.

The lamellae (ridges) are thicker than in *F. Wondraczeki* and project further from the margin: their appearance on the margin depends a good deal on the angle at which they are seen. In this way the lamellae may appear as spines

with a broad base, or even as if giving a winged appearance here and there if it so happens that the lamellae are sinuose at the point of observation. The var. *decipiens* Corbière, judging from a specimen from the author of the variety, varies greatly in the amount of winged appearance, this being sometimes practically absent; the lamellae in this specimen are more sinuous than in the typical plant, and this is in great part the cause of the winged appearance; with the greater sinuosity is also seen a larger amount of anastomosing in the centre of the face. I have seen this variety from Lancashire and from the island of Islay and Nicholson records it from Sussex.

Var. *ochroleuca* Lindb., judging from a specimen sent by M. Corbière, hardly differs from the type. The yellow colour of the spore is not constant, and although there is frequently a considerable amount of anastomosing of the lamellae, this varies greatly in the same capsule, and may even be absent. This form also occurs in Britain.

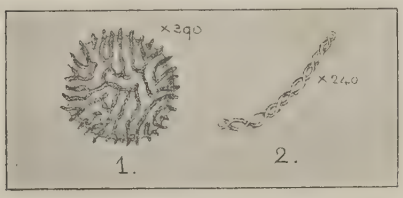
The inner layer of the capsule-wall in this species has many of the semi-annular thickenings complete. In *F. Wondraczeki* they are rarely so. It forms larger patches than that plant does, and is more odorous. It is also a more southern species. In both species when the spore begins to decay the lamellae frequently do not form continuous ridges throughout their length. This gives the spore the appearance of being partly spinous.

44. Fossombronia Wondraczeki (Corda) Dum.

Jungermannia Wondraczeki Corda in Sturm, Deutsch. Fl. II Fasc. 19–20 p. 30 (1830).

Fossombronia Wondraczeki Dum., Rec. d'observ. p. 11 (1835).

Fossombronia cristata Lindb., Soc. pro F. et Fl. Fenn. (1873).



1. Spore. 2. Elater.

Paroicous. In small pale green patches or gregarious, slightly odorous. Stems to 10 mm long, midrib nearly semicircular, flat above, about twice as broad as high. Lower leaves distant or approximate, recurved, obcuneate, emarginate or shortly bilobed, the upper leaves crowded, oblong-quadrate, sinuate-crispate, entire or variously lobed, lobes frequently acute. Pseudoperianth 1·3–1·5 mm long, campanulate, sinuate-lobulate, lobes frequently acute. Pedicel of capsule 2–3 mm long. Inner layer of capsule-wall with *a few, mostly incomplete* semi-annular thickenings. Spores 36–44 μ, reddish-brown, *with many sinuous nearly parallel lamellae, some anastomosing*, especially in the centre of the face, the lamellae appearing on the margin as *28–36* short, more or less truncate spines. Elaters 8–9 μ broad, 2–3-spiral, yellowish-brown.

HAB. On bare, moist soil in cult. fields, footpaths, sides of ditches and at the sides of ponds.

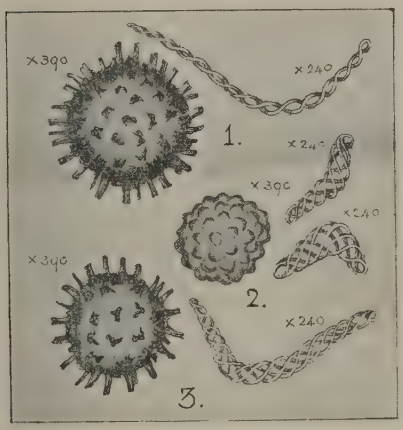
DISTRIB. N. to Caithness, frequent; Ireland. Fr. July–Nov.

The more numerous lamellae will distinguish this readily from *F. pusilla* and there is also more anastomosing of the lamellae in the centre of the face. The difference in the inner layer of the capsule-wall is also noticeable.

45. Fossombronia caespitiformis De Not.

Fossombronia angulosa β *caespitiformis* Raddi in Atti Soc. Ital. Sci. Mod. 18 p. 41 (1818).

Fossombronia caespitiformis De Not. in Gott. et Rabh., Hep. Eur. Exs. No. 123.



1. Spore and elater, normal form.
2. Spore and elaters, "verrucosa" form.
3. Spore, small form, with 4-spiral elater.

Heteroicous. In small thin pale green patches or gregarious, odorous. Stems to 5 mm long, subterete, the upper surface nearly plane or slightly channelled. Leaves broadly obcuneate, entire or sinuate-lobulate, closely imbricate and greatly crispate at the apex of the stem. Pseudoperianth broadly campanulate, the mouth sinuate-lobed, lobes very obtuse. Inner layer of capsule-wall with for the greater part incomplete semi-annular thickenings. Spores 45–50 μ, reddish-brown, *the face hispid with truncate, compressed, free papillae 5–6 μ long*, those appearing across the face *6–8* in number, a few of the papillae sometimes coalescing to form imperfect lamellae. Elaters 8–9 μ broad and 2–3-spiral, rarely to 14 μ broad and 3–5-spiral.

HAB. On bare damp soil in cultivated fields and on banks.

DISTRIB. From Sussex and Cornwall to Westmoreland; rare. Ireland. Fr. Aug.–Nov.

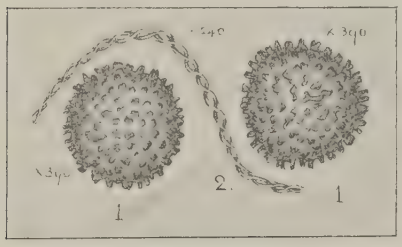
The papillae are long, to 6 μ, this being noticeable in profile; they are flat with the apex truncate; frequently some of them coalesce so as to form imperfect lamellae; when this occurs to any considerable extent it forms the var. *subcristata* Schiffn.

In *F. Husnoti*, which may be expected to occur in the south of England, the lamellae more or less form areolae on the face of the spores, the angles being elevated into papillae which are compressed and truncate as in *F. caespitiformis*, and giving the margin a similar appearance, but these papillae are much shorter.

F. caespitiformis is a southern species. It frequently grows to a considerably larger size in the south of Europe than it does in England. The spores of this species are occasionally imperfectly developed, being smaller and with the papillae shorter or even reduced to obtuse warts. In these cases the elaters frequently become short and thick, being 3–5 spiral. This imperfect form is, I believe, the *F. verrucosa* of Lindberg. See further, on this point, *Revue Bryol.* p. 74 (1911).

46. Fossombronia Mittenii Tindall

Fossombronia Mittenii Tindall in Journ. Bot. p. 44 *pl.* 382 B (1898).



1. Spores. 2. Elater.

Monoicous? In small bright yellowish-green patches. Stems 4–5 mm long, simple; rhizoids numerous, violet. Leaves imbricate, more crenulate than lobed, much crisped, slightly angled; cells at middle of leaf 56 × 38 μ; the uppermost leaves sinuate-crispate and slightly denticulate. Pseudoperianth broadly campanulate, the mouth crispate, inciso-lobate, the lobes longly acuminate. Inner layer of capsule-wall with some semi-annular thickenings. Spores *42–51 μ* (average 47 μ), dark reddish-brown, not at all transparent, *with very numerous fine, narrow and compressed separate papillae, 2–4 μ long, 10–12 in number across the face, mostly truncate at the apex* but sometimes rounded or occasionally emarginate, rarely with 2–5 papillae joining to form an incomplete ridge, *the margin appearing closely spinous*. Elaters 6–8 μ broad, pale yellow, laxly bispiral.

Hab. On roadside bank.

Distrib. Luxor Hill, Devon, 1875 (*W. Mitten*).

I am indebted to Mrs. Tindall for the loan of two micro-slides of the original plant. From these Mr. Jameson has taken the drawings. It is a very distinct species, unlike any other British *Fossombronia*. It is more nearly allied to *F. caespitiformis* than to the others, but cannot be mistaken for it. *F. Mittenii*

has the body of the spore rather larger, the papillae greatly more numerous,—about 10–12 can be counted across the face instead of 6–8 in the other, —shorter, less thick at the base and much narrower, the elaters considerably narrower and more laxly bispiral.

The papillae are distinctly compressed, separate and rather narrow at the base, the apex is narrow but is generally truncate.

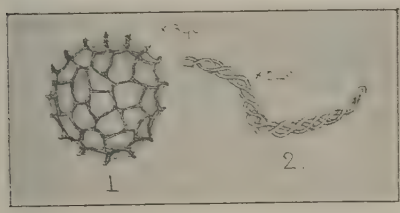
The measurement of the leaf-cells will probably vary from the size given in the description, as only one leaf was seen.

Mrs. Tindall mentions in the *Journ. Bot.* that the plant is slightly larger and less delicate than *F. Wondraczeki* but smaller than *F. pusilla*.

F. echinata, which is described in *Revue Bryol.* p. 73 (1911), from Algeria and the south of Europe, has smaller spores, 35–41 μ broad, with narrower and acute or subacute papillae.

47. Fossombronia Dumortieri (Hüb. et Genth.) Lindb.

Codonia Dumortieri Hüb. et Genth., Deutsch. Leberm. No. 80 (1837).
Fossombronia Dumortieri Lindb., Not. pro F. et Fl. Fenn. 13 p. 380 (1874).



1. Spore. 2. Elater.

Heteroicous. In rather extended, dense, intricate pale green patches, strongly odorous. Stems to 7 mm long, midrib greatly convex and nearly ovate below, slightly convex above. Leaves obliquely obcuneate, sinuate-lobulate, composed of a very short bistratose layer arising suddenly from the midrib and passing into the 1-stratose layer. Pseudoperianth 1·75 mm long, turbinate, the mouth sinuate-lobulate, occasionally with one or more teeth. Pedicel of capsule 2 mm long. Inner layer of capsule-wall with thick, mostly incomplete semi-annular thickenings. Spores 37–44 μ, brownish-yellow, *regularly reticulate*, the lamellae low, *forming 6–7 areolae across the diameter of the face*, the areolae 5–6-angled, 7–9 μ in diam., margin of spore appearing as if *crenulate-dentate*, the teeth being *16–20* in number. Elaters 8–10 μ broad, pale yellowish-brown, 2–4 spiral.

Hab. On low moors and damp sandy ground.

Distrib. N. to Inverness, uncommon. Ireland, Fr. July–Nov.

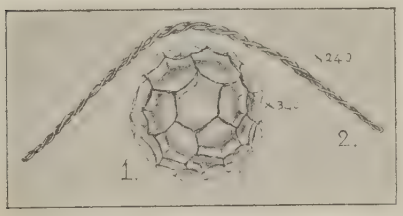
Is more strongly odorous than the others and has in general a different habitat. The spores are quite different in appearance from our other areolate

species *F. angulosa*. In the present plant, the areolae are much more numerous and smaller and the margin does not appear winged.

F. Crozalsii Corb. in *Revue Bryol.* 1903 p. 13, may occur in the south of England. The face of the spore is areolate as in *F. Dumortieri*, but the areolae are smaller and more numerous, and the lamellae are higher, this causing the margin to appear as if spinulose.

48. **Fossombronia angulosa** (Dicks.) Raddi

Jungermannia angulosa Dicks., Pl. Crypt. Fasc. 1 p. 7 (1785).
Fossombronia angulosa Raddi in Atti Soc. Ital. Sci. Mod. 18 p. 40 (1818).



1. Spore. 2. Elater.

Dioicous. In *large*, extended, dense, intricate and crispate patches, pale green, *becoming brownish-yellow by age.* Stems to 15 mm long, flat above, strongly convex below, with numerous long rhizoids attaching them to the substratum and to each other. Leaves composed of 3–4 layers of cells at base followed by a short 2-stratose layer to the 1-stratose layer, imbricate, oblong-quadrate to broadly cuneate, irregularly sinuate-lobed, lobes mostly small and frequently hardly apparent, obtuse, less frequently acute, sometimes spinous-ciliate with occasionally one or more teeth placed irregularly on the margins; cells of base of leaf greatly larger than at the apex. Pseudoperianth turbinate, the mouth sinuate and slightly lobed, lobes sometimes acute. Pedicel of capsule 6–7 mm long. Inner layer of capsule-wall with *mostly complete* semi-annular thickenings. Spores 35–42 μ, reddish-brown, *regularly reticulate*, the lamellae *high*, compressed, *forming 3–5 hexagonal areolae across the diameter of the face*, 10–13 μ in diam. Margin of spore appearing as if surrounded with a *broad*, *transparent angulate wing*, the angles *10–12 in number.* Elaters long, 7–8 μ broad, bispiral. ♂ plant rather smaller than the ♀; antheridia numerous, very shortly pedicellate, partly covered by lanceolate to cuneate, frequently dentate bracts and by an antical tooth sometimes present at base of the leaves.

Hab. In moist places among rocks and on ditch sides, near the sea.

DISTRIB. Cornwall; Wales; rare. S.W. and W. of Ireland. Fr. Jan.–May.

This is a much larger plant than any of the others and can be recognised at once by its size. When the leaves are decaying, the stems remain green for a time and are conspicuous. It is a southern species and is confined with us to the neighbourhood of the coast. The spores with their large areolae and the translucent wings do not resemble those of the other species.

SUBFAMILY **Haplomitrioideae**

Haplomitrieae Dedecek; *Calobryaceae* Goebel.

Stems erect, arising from a fleshy rhizomatous-like basal portion. *Leaves arranged radially* and more or less regularly in three rows, simple (not bilobed). *Rhizoids absent.* ♀ inflorescence on the upper part of the stem, without an involucre. Calyptra large, cylindrical. Capsule cylindrical, the wall of one layer of cells except at the apex, with *longitudinal* annular thickenings. Elaters bispiral.

This aberrant group, containing the genera *Haplomitrium* and *Calobryum*, differs from all other hepatics in having the leaves arranged radially on the stem instead of dorsiventrally, although the radial arrangement is not recognisable near the lower part of the stem. The stem grows from a three-sided apical cell as in the acrogynous *Jungermanniaceae*, but the apical cell does not develop into an archegonium in *Haplomitrium;* it does so in *Calobryum*, so that the stem is acrogynous in the latter.

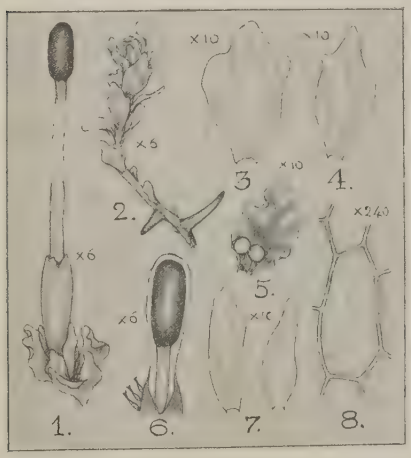
XIX. HAPLOMITRIUM Nees

Scalius S. F. Gray, Nat. Arr. Brit. Pl. 1 p. 704 (1821).
Mniopsis Dum., Comm. Bot. p. 114 (1822).
Haplomitrium Nees, Eur. Leb. I p. 109 (1833).

Stem erect, arising from a *fleshy branched rhizomatous-like* basal portion, *entirely without rhizoids*. Leaves oblong, arranged more or less distinctly *in three rows*. Archegonia naked, solitary in the *axils of small leaves* near the apex of the stem. Calyptra long, narrowly *cylindrical*, thick, surrounded at the base by a few sterile archegonia. Capsule longly pedicellate, cylindrical, 2–4-valved, but dehiscing irregularly; wall unistratose with *longitudinal* brown annular thickenings. Elaters long, slender, bispiral. Antheridia *irregularly scattered around the stem*, broadly oval, orange, with a thick pedicel; bracts large, oblong-ovate.

49. Haplomitrium Hookeri (Sm.) Nees

Jungermannia Hookeri Sm., Eng. Bot. *pl.* 2555 (1813); Hook. Brit. Jung. *pl.* 54 (1813).
Scalius Hookeri Gray, Nat. Arr. Brit. Pl. 1 p. 705 (1821).
Gymnomitrion Hookeri Corda in Opiz, Beitr. p. 651 (1829).
Haplomitrium Hookeri Nees, Eur. Leb. I p. 111 (1833).



1. Apex of fertile plant. 2. Barren plant. 3. Leaf. 4. Leaf of third row. 5. Male bract with antheridia. 6. Calyptra with enclosed capsule. 7. Floral leaves. 8. Cells.

Dioicous. In *small erect loose tufts* or scattered stems, *pale green* when fresh, dark green and *shrinking when dry*. Stem 3–9 mm long, with the basal rhizomatous portion 3–7 mm long, *simple* or occasionally with a lateral branch, *thick and succulent*, slightly compressed dorsally, about 16 cells wide, cells large, the exterior row smaller. Lower leaves obliquely inserted, incubous, alternate, upper leaves much larger, and imbricate, transverse, *erecto-patent*, sometimes recurved, varying greatly in shape, concave, *oblong-ovate to ligulate, frequently with two small lateral lobes* in the upper part and a larger triangular obtuse lobe forming the apex, margins occasionally irregularly and obtusely dentate; cells 4–6-angled with thin walls and angles not thickened, 27–38 μ at apex, 35–42 μ in the middle, 56–63 μ at base, with numerous chlorophyll granules. Third row of leaves alternate with the others, *of the same shape, transversely inserted*. Floral leaves narrow, ligulate, entire. Calyptra *linear-oblong, longly exserted* from the stem leaves. Pedicel of capsule to 8 mm long. Capsule 1·8 mm long and ·5 mm broad, *cylindrical*, pale brown. Spores 23–28 μ, rotund and oblong-rotund, thickly papillose, dark greenish-brown. Elaters 250–500 μ, rarely to 620 μ long, 8–9 μ broad, longly attenuate, nearly colourless, mostly bispiral, with some attached to the apex of the valves and with several broad and short, frequently monospiral, elaters at the base of the capsule. ♂ plant rather smaller, bracts in the upper part of the stem,

at first erect, later erecto-patent to patent, resembling the leaves, margin more or less irregularly lobulate-dentate and with frequently a few papillae on the margin; antheridia 260 μ × 200 μ, broadly oval, pale *orange*, *exposed*, *irregularly scattered on the stem* and in the axils of the bracts, the pedicel of nearly equal length to the antheridium.

HAB. In moist sandy or peaty ground.

DISTRIB.. N. to Forfar, very rare. Ireland. Fr. Oct.–Nov.

This small species is very difficult to detect in the field. The pale green tufts seem to be always composed of only a few stems. The accompanying plants in one locality were *Aneura pinguis*, *A. multifida*, *Hypnum revolvens*, *Scirpus multicaulis*, *Juncus supinus* and *Selaginella*. It bears a good deal of resemblance in colour and habit to young plants of the last species, or sometimes to a *Bryum*. With the lens it is easily identified, being unlike any other species, and the orange coloured antheridia are conspicuous in the male plant. Rhizoids are altogether absent, but the fleshy rhizomes, which render the rhizoids unnecessary, are very noticeable. The plant shrivels on drying and recovers its former state imperfectly.

The profile of the spore is somewhat irregular, but hardly angular.

FAMILY V. JUNGERMANNIACEAE ACROGYNAE

Gametophyte a stem *with two lateral rows of leaves* and frequently a third postical row. *Archegonium arising from the apical cell*, the sporogonium being therefore terminal on the stem or branches. The involucre (perianth) *representing true leaves*.

*1 { Leaves almost entirely divided up into filiform segments.....2
{ Leaves with a part of the lamina (at least) evident.....4

* The Key to *Jungermanniaceae acrogynae* has been arranged by H. G. Jameson.

2 { Plant large; leaves many times divided, with very numerous segments *LVIII. Trichocolea*
Plant slender; leaves with 3 or 4 segments....3

3 { Leaf-segments only 1 cell wide throughout....*LII. Blepharostoma*
Leaf-segments 2 cells wide in their lower part....*LI. Lepidozia*

* * *

4 { Leaves with a (usually small) postical lobe bent up behind the antical....5
Leaves without an incurved postical lobe....18

5 { Underleaves absent....6
Underleaves present....8

6 { Leaves large, tumid, toothed near apex....*LXII. Pleurozia*
Leaves entire, or merely echinate with projecting cells....7

7 { Minute plants, with thread-like, translucent stem; rhizoids attached to the stem....*LXV. Cololejeunea*
Plants larger; rhizoids attached to the postical lobe....*LXI. Radula*

8 { Postical lobe with a very narrow, stalk-like base, helmet-shaped....9
Postical lobe not helmet-shaped....10

9 { Leaves toothed....*LXXI. Jubula*
Leaves entire....*LXXII. Frullania*

10 { Underleaves notched or 2-lobed....11
Underleaves not notched or 2-lobed....17

11 { Leaves spinous-toothed or ciliate....12
Leaves entire or minutely denticulate....13

12 { Leaves fringed with long cilia....† *LVII. Ptilidium*
Leaves spinous-toothed....*LVI. Mastigophora*

13 { Leaves with a long, hollow apex, like a calyptra....*LXIV. Colurolejeunea*
Leaves not calyptriform....14

14 { Lobes of underleaves divergent....15
Underleaves with a narrow sinus, the lobes not divergent....16

15 { Leaves with slender, toothed apex; lobes of underleaves acute *LXVIII. Drepanolejeunea*
Leaves with wider, entire apex; lobes of underleaves obtuse *LXIX. Harpalolejeunea*

16 { Lobes of leaves nearly equal in size....*LXVII. Microlejeunea*
Lobes very unequal (in most of the leaves)....*LXVI. Lejeunea*

17 { Postical lobe of leaves nearly parallel to the stem; underleaves oblong *LXIII. Madotheca*
Postical lobe nearly at right angles to the stem; underleaves roundish *LXX. Marchesinia*

* * *

18 { Leaves incubous (i.e. obliquely inserted, with the antical margin directed towards the apex of the stem)....19
Leaves transversely inserted, or arranged all round the stem, or succubous (i.e. the antical margin directed towards the base of the stem)....22

19 { Leaves divided half-way or more into 3–6 lobes....*LI. Lepidozia*
Leaves not divided half-way....20

20 { Underleaves absent; leaf-margin toothed....‡ *XLVIII. Adelanthus*
Underleaves conspicuous....21

† Cf. *Trichocolea* (see under No. 2), with the lamina almost disappearing in the filiform segments.

‡ *A. dugortensis*. The leaves are really succubous by their insertion, but so twisted backwards as to appear as if incubous.

21 { Plant firm, green or brownish ; leaves usually 3-toothed at apex *L. Bazzania*
Plant delicate, pale ; leaves entire or bifid ..... *XLIX. Calypogeia*

* * *

22 { Underleaves similar to, and as large (or nearly so) as the leaves 23
Underleaves differing from, and usually much smaller than the leaves, or absent 26

23 { Leaves with 3 or 4 lobes ..... *LIII. Chandonanthus*
Leaves with only 2 lobes 24

24 { Leaves falcato-secund, with very long, acuminate lobes ..... *LV. Herberta*
Leaves erect or nearly so 25

25 { Leaves divided below the middle, usually closely imbricate ... *LIV. Anthelia*
Leaves not divided half-way, distant ..... *XLV. Hygrobiella*

* * *

26 { Leaves obtuse and entire, neither lobed nor toothed 27
Leaves (or some of them) distinctly 2- or more lobed, or with one or more teeth on their margin 38

27 { Stem with flagella ..... *XLVII. Odontoschisma*
Stem without flagella 28

28 { Leaves large, with large cells (45 μ or more) and very marked trigones ; either coarsely papillose, or with gemmae at their tips ... *XXXIV. Leptoscyphus*
Leaf-cells under 45 μ ; leaves neither coarsely papillose, nor gemmiferous ... 29

29 { Leaves on either side of the stem closely pressed face to face 30
Leaves not closely vertically appressed 31

30 { Leaves longly decurrent, the cells markedly stellate ; plant tall, ochraceous *XXV. Jamesoniella*
Leaves very shortly decurrent, the cells not stellate ..... *XXII. Alicularia*

31 { Underleaves present 32
Underleaves absent 37

32 { Leaves minute, wedge-shaped, caducous ; plant epiphytic *XXXIV. Leptoscyphus*
Leaves not wedge-shaped ; plant not epiphytic 33

33 { Underleaves rather large, either deeply bifid or coarsely toothed 34
Underleaves subulate, or small and subentire 35

34 { Underleaves with two slender lobes ..... *XXXVI. Chiloscyphus*
Underleaves wide, with coarse teeth ..... *XXXIX. Saccogyna*

35 { Leaf-cells with oil-bodies ; lower half of perianth adherent to the bracts *XXII. Alicularia*
Leaf-cells without oil-bodies ; perianth free 36

36 { Mouth of perianth wide ; plant growing on limestone *XXXIII. Pedinophyllum*
Mouth of perianth contracted ; plant rarely on limestone *XXV. Jamesoniella*

37 { Perianth adherent to the bracts ; rhizoids usually purple ... *XXIII. Eucalyx*
Perianth free (or nearly) ; rhizoids white ..... *XXIV. Aplozia*

* * *

38 { Leaves transversely inserted, or with an antical lobe bent up over the postical 39
Leaves obliquely inserted, with no conduplicate lobe 54

39 { Leaf-lobes ending in a long, curved filiform point ..... *XLI. Nowellia*
Lobes without long, filiform points 40

40 { Leaves, at least the upper, three- or more lobed 41
Leaves all two-lobed 42

41 { Lobes obtuse, entire, or the antical one a mere tooth; underleaves absent *XXIX. Sphenolobus*
Lobes acute (or subacute); underleaves present, or else leaves toothed *XXVIII. Lophozia*

42 { Antical lobe distinctly smaller than the postical 43
Lobes equal or very nearly so 46

43 { Leaves shortly lobed at the tip only, usually antically secund *XXVI. Anastrophyllum*
Leaves deeply lobed, or with a tooth on the antical margin 44

44 { Antical lobe small and tooth-like, or lanceolate and tapering, or, if wider, postical lobe much incurved at tip ..... *XXIX. Sphenolobus*
Antical lobe oblong, ovate, or roundish, postical not incurved 45

45 { Antical lobe oblong, with more or less parallel sides; perianth with a contracted plicate mouth ..... *LIX. Diplophyllum*
Antical lobe varying from ovate to roundish, but never oblong, perianth with a wide, flattened mouth ..... *LX. Scapania*

46 { Underleaves conspicuous, nearly as long as the roundish, very concave leaves ..... *XLVI. Pleuroclada*
Underleaves very small or absent 47

47 { Perianth absent, or adherent to the inner bracts; leaves usually silver-grey, or blackish, or reddish brown 48
Perianth free; leaves usually green or pale 49

48 { Innermost bracts not united to form a perianth; leaves (except in *G. alpinum*) erect and closely imbricated ..... *XX. Gymnomitrium*
Inner bracts united to form a perianth; leaves imbricated or distant, frequently spreading ..... *XXI. Marsupella*

49 { Leaves 1 mm or more long; perianth wide and flat at apex ... *LX. Scapania*
Leaves under 1 mm; perianth contracted at apex 50

50 { Leaf-lobes acute, more or less spinous-toothed ..... *XLIII. Prionolobus*
Leaf-lobes entire or subdenticulate (or with a few teeth in *Cephaloziella elachista*) 51

51 { Cladocarpous; upper leaves frequently oblique ..... *XL. Cephalozia*
Acrocarpous 52

52 { Leaves much longer than width of stem; perianth without a third (postical) angle ..... *XXIX. Sphenolobus*
Lower leaves scarcely longer than width of stem; perianth with a third (postical) angle 53

53 { Branches lateral; perianth obtuse and rounded at apex ... *XLIV. Eremonotus*
Branches postical; perianth not rotundate at apex ..... *XLII. Cephaloziella*

* * *

54 { Underleaves conspicuous (deeply bifid, or toothed, or ovate and entire) ... 55
Underleaves small (usually subulate) or absent 58

55 { Underleaves ovate-lanceolate or ovate, usually entire .. *XXXVII. Harpanthus*
Underleaves bifid, or toothed, or narrow-lanceolate 56

56 { Underleaves divided nearly to the base into 2 parallel, entire lobes; plant cladocarpous ..... *XXXVIII. Geocalyx*
Underleaves toothed at base, or not bifid; acrocarpous 57

57 { Leaves delicate and transparent, with finely tapering lobes or teeth; perianth deeply 3-lobed ..... *XXXV. Lophocolea*
Leaves obtuse, acute, or mucronate; perianth shortly lobed at mouth only *XXVIII. Lophozia*

58 Leaves (or several of them) with more than 2 lobes, or with numerous teeth 59
Leaves 2-lobed only, or some of them entire and obtuse 61

59 Leaves varying, with 1 to 3 teeth, more or less distinctly bordered, the antical margin reflexed ..... *XLVIII. Adelanthus*
Leaves not bordered 60

60 Leaves with spinous teeth, mostly towards the postical margin, the antical margin entire, and usually reflexed ..... *XXXII. Plagiochila*
Leaves with 3 or 4 obtuse or acute terminal lobes, or with teeth on the antical margin ..... *XXVIII. Lophozia*

61 Stem pellucid, with large, thin outer cells, or else with flagella ..... *XL. Cephalozia*
Stem opaque, not flagelliferous 62

62 Leaves ½-divided, with narrowly tapering lobes 63
Lobes obtuse or acute, but not finely tapering 64

63 Leaves narrow at base, more or less wedge-shaped, caducous ..... *XXXII. Plagiochila*
Leaves wide at base; involucre at right angles to stem ..... *XXX. Acrobolbus*

64 Postical leaf-margin strongly reflexed, leaves wide, very shortly lobed at apex ..... *XXXI. Anastrepta*
Postical margin not markedly reflexed 65

65 Plant small, creeping; perianth partly adherent ..... *XXII. Alicularia*
Plant various in size; perianth free 66

66 Some of the leaves obtuse and entire, or very shortly emarginate ..... *XXXII. Plagiochila*
All the leaves lobed 67

67 Bracts larger than the leaves, embracing base of perianth; (leaf-lobes various, obtuse or acute) ..... *XXVIII. Lophozia*
Bracts not larger than the leaves, not embracing the perianth; (leaf-lobes obtuse or subacute only) ..... *XXVII. Gymnocolea*

Subfamily **Lophozioideae**

Epigoniantheae Spruce; *Epigoniantheae* Schiffn.; *Lophoziaceae* Cavers.

Plants usually large, rarely small. Stems irregularly branched, very rarely pinnate; branches almost always lateral. *Leaves succubous or transversely inserted*, entire or 2-lobed, seldom 3–5-lobed, the antical portion being often much recurved. Underleaves generally absent or small, very rarely large. Inflorescence acrogenous, very seldom cladogenous. *Perianth* (when present) *normally compressed from the side*, cylindrical, or ovate and plicate, or trigonous with *the third angle always antical*. Some genera marsupial. Capsule mostly ovate or cylindrical, 4-valved to the base. Elaters deciduous, attenuate at both ends, normally bispiral. Androecia very seldom on special branches; bracts with 1–10 antheridia.

XX. GYMNOMITRIUM Corda

Cesius S. F. Gray, Nat. Arr. Brit. Pl. 1 p. 705 (1821).
Gymnomitrium Corda in Opiz, Beitr. 1 p. 651 (1829).
Acolea Dum., Syll. Jung. Eur. p. 76 (1831).

Plants *small*, *densely pulvinate*, often glaucescent or fuscous. Stem erect or ascending, often much branched, frequently stoloniferous. Leaves *transversely inserted*, usually closely imbricated and increasing in size towards the apex of the stem, *strongly concave*, more or less deeply *bilobed* with the apex of the lobes often hyaline. *Underleaves absent.* Inflorescence terminal. Involucral bracts larger and much broader than the leaves; inner bracts smaller, hyaline and lobed. *Perianth absent.* Calyptra free, with generally some *sterile archegonia on the upper part of its surface.* Capsule globose, composed of two layers of cells. Elaters 2–4-spiral. Gemmae absent.

This genus is closely related to *Marsupella* and has been considered by Spruce and Pearson as only artificially separated from it, but for practical purposes, at least, it must be kept distinct. In *Gymnomitrium* the inner cycle of floral leaves—named by Schiffner the "perianth leaves"—are distinct leaves free from one another, or one or more of them joined at the base or rarely united into a short tube, but they are never united together so as to form a tube having a narrowed, evenly crenulate mouth as in *Marsupella*, the lobes of the perianth leaves being still recognisable. In *Gymnomitrium* the inner cycle is always free from the next outward cycle—the involucral bracts—while in *Marsupella* the two are concrete for some distance; also in the latter genus the involucral bracts are more or less highly connate with one another. The position of the unfertilised archegonia is also of importance. In *Gymnomitrium* these are attached to the upper part of the calyptra, while in the other they surround the base or at least its lower part. The typical species of the genus with their closely tiled and mostly whitish leaves are generally quite easily recognised from other hepatics; they can only be confused with the rare species belonging to the subgenus *Hyalacme* of *Marsupella*. The plants belonging to the subgenus *Homocraspis* resemble the small brown species of *Marsupella* and require dissection to distinguish between them. Some practice is necessary for this, as the bracts must be dissected off separately; a longitudinal incision through the inflorescence with its envelopes will also show the relation of the parts to each other; the position of the unfertilised archegonia can however be readily seen by even a rough dissection. Several species of the two genera grow in somewhat extensive brown patches on soil about the summits of the hills, and are much like each other in appearance. They mostly appear just above the surface of the ground and are apt to be overlooked, but when once seen, their appearance becomes familiar. None of the species are found below the subalpine region, and most of them are distinctly alpine.

1 { Leaves closely imbricated, giving the stem a plaited appearance 2
  { Leaves erecto-patent or patent; plant with the appearance of *Marsupella* ... 5

2 { Minute, purple, more rarely olive green, marginal row of cells elongate
  { *53. crenulatum*
  { Larger, white, occ. glaucous-green to brownish-yellow, marginal row of cells not elongate 3

3 { Leaves hardly appearing distinct through being very closely imbricated, margins much lacerated except in young branches, which show a small acute sinus, cuticle quite smooth ..... *52. corallioides*
Leaves distinctly seen, margins not or little lacerated, sinus deeper, cuticle roughened 4

4 { Sinus acute and open, lobes acute, margins entire (crenulate in var. *intermedium* ..... *50. concinnatum*
Sinus acute but closed, deeper, lobes rotundate, distinctly crenulate *51. obtusum*

5 { Leaves shining, patent from an erect sheathing base; stem 1·5–3 cm or more in length..... *57. alpinum*
Leaves dull, erecto-patent; plant smaller 6

6 { Paroicous; leaves oval or oblong, sinus rounded, lobes rather obtuse *54. adustum*
Polyoicous or dioicous; leaves quadrate-ovate or subrotund, sinus not rounded, lobes acute 7

7 { Polyoicous; leaves exactly transverse; stem with few rhizoids...*55. varians*
Dioicous; leaves looking towards the antical side; stem with many rhizoids *56. crassifolium*

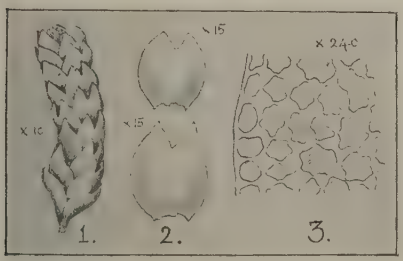
Subgen. **Eugymnomitrium** K. Müll.

Cesia B. *Eucesia* Lindb., Musc. Scand. p. 9 (1879).
Gymnomitrium Sect. I. *Typicae* Schiffn., Engl. and Prantl I 3 p. 77 (1893).
Eu-Gymnomitrium K. Müll., Rabh. Krypt. Fl. p. 415 (1909).

Plant whitish-green to yellowish, rarely brown. Leaves very closely imbricate, the margin and apex more or less hyaline.

50. Gymnomitrium concinnatum (Lightf.) Corda

Jungermannia concinnata Lightf., Fl. Scot. p. 786 (1777).
Cesius concinnatus Gray, Nat. Arr. Brit. Pl. 1 p. 705 (1821).
Gymnomitrium concinnatum Corda in Sturm, Deutsch. Fl. fasc. 19 p. 23 (1829).
Acolea concinnata Dum., Syll. Jung. Eur. p. 76 (1831).



1. Sterile branch. 2. Leaves. 3. Cells.

Dioicous. In dense tufts, *brownish-yellow* to greenish-white, occasionally silvery in colour. Stems to 2·5 cm long, simple or sparingly branched, *sterile branches round* and of nearly the same diameter throughout, the sexual branches clavate and slightly compressed. Leaves 1 mm long, densely imbricated, *slightly secund antically*, broadly oval, very concave, the antical margin reflexed,

indistinctly or not hyaline at the margin, ½ bilobed, sinus *acute and open lobes broadly triangular, acute* or occasionally somewhat obtuse, the margin *entire* or with a few indistinct, irregular crenulations in the upper part; cells near margin rotund-quadrate with greatly and nearly equally thickened walls, at middle of leaf 18–21 μ with less thickened walls but with large trigones, at base of leaf larger with thin walls and small trigones; cuticle *minutely verruculose*. ♀ inflorescence ovate; involucral bracts involute, rather deeply lobed, lobes acute; inner bracts irregularly lobed, dentate and *laciniate*. Capsule spherical, dark brown, pedicel 3·5 mm long. Spores 12–15 μ, reddish-brown, minutely verruculose. Elaters of same colour, bispiral. ♂ bracts in several pairs, similar to the leaves but less closely imbricated, the antical margin reflexed; antheridia in pairs, oval, on a long pedicel.

var. **intermedium** Limpr., Neue Musc. für. Schles. p, 186 (1876).

Margins of the lobes of leaves distinctly crenulate. Otherwise as the type.

Hab. On rocks and soil in the alpine region, seldom in the subalpine, ascending to 4400 ft. alt.

Distrib. Wales and Yorkshire to Shetland, common on the higher hills of the Highlands, rare elsewhere. Fr. June–Aug.

In exposed ground about the summits of mountains, the leaves are frequently so closely imbricated as to be hardly distinguishable and are sometimes eroded on the margin. Such plants are generally white and are liable to be confused with *G. corallioides;* the latter, however, has more intricate tufts, sterile branches arcuate, lanceolate and compressed, and the colour is dark grey to almost black. The same remarks apply to *G. obtusum* in its relation to *G. corallioides*, but in their usual forms the two commoner species are quite distinct in appearance from the rarer one, and the outline of their leaves is easily seen.

There are frequently a few crenulations on the margin of the lobes of *G. concinnatum;* when these occur in some quantity, the plant is the var. *intermedium* Limpr. This slight variety is sometimes mistaken for *G. obtusum*, but its sinus is open as in the typical plant, and though the lobes may be rather obtuse, they are never rotundate, and the crenulations hardly extend below their base.

The cell-structure varies considerably. In some plants of exposed ground, especially the reddish or yellowish-brown forms, the cells are greatly incrassate as in fig 3. In the pale coloured forms, the cuticle is occasionally, though rarely, nearly smooth.

Marsupella apiculata Schiffn. which is referred to under *M. condensata*, might be mistaken for some of the smaller and darker, closely imbricate-leaved forms of *G. concinnatum*. It is rather smaller than any form of this species and is of a darker reddish-brown colour and glistening when moist. Under the microscope, the leaves are seen to be more quadrate, lobes apiculate with 1–2 hyaline cells, angles of cell-walls less thickened and the cuticle smooth.

51. Gymnomitrium obtusum (Lindb.) Pears.

Cesia obtusa Lindb., Musc. Scand. p. 9 (1879).
Gymnomitrium obtusum Pears., Journ. Bot. p. 337 (1880).
Acolea obtusa Bernet, Cat. Hép. Suisse p. 24 (1880).

1. Sterile branch. 2. Leaf. 3. Cells.

Dioicous. In dense tufts, *whitish*, or pale green, rarely somewhat reddish-brown towards the apex of the stem. Stems to 2 cm long, simple or sparingly branched, *sterile branches round* and of nearly the same diameter throughout, the sexual branches clavate and slightly compressed. Leaves ·6–·9 mm long, densely imbricated, *symmetrically* appressed, broadly oval, very concave, the antical margin reflexed, almost the entire margin and the upper half of leaf *broadly hyaline*, $\frac{1}{4}$–$\frac{1}{6}$ bilobed, *sinus very acute but closed*, *lobes rotundate*, *distinctly and regularly crenulate*, the crenulations extending to *nearly the base* of the leaf; cells slightly larger than in *G. concinnatum*, 18–24 μ in the middle of the leaf; cuticle *minutely verruculose*. ♀ inflorescence ovate; involucral bracts *involute*, lobes *rotundate*; inner bracts irregularly and shallowly lobed, the lobes subacute, crenulate. Capsule spherical, dark brown. Spores 12–14 μ, minutely verruculose. Elaters bispiral. ♂ bracts in several pairs, similar to the leaves, the antical margin reflexed; antheridia in pairs.

Hab. On rocks, seldom on soil in the subalpine and alpine regions, ascending to 3900 ft. alt.

Distrib. Wales and Yorkshire to Caithness, common in the Highlands above 1200 ft. alt., frequent in North Wales and the Lake District; Ireland. Fr. June–Aug.

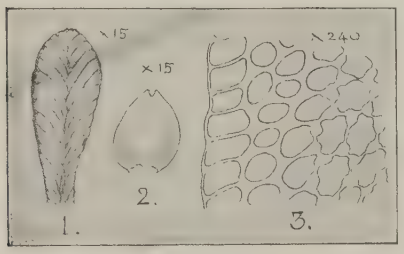
The reddish or yellowish-brown colour, which is usual in *G. concinnatum*, is uncommon in this species, and when present is mostly confined to the apex of the stems; the leaf sinus is closed, the inner margins of the lobes sometimes overlapping; the crenulations extend to nearly the base of the leaf, and the leaves are much more hyaline than in the other.

This species descends to a lower level and is less common than *G. concinnatum* at high altitudes. It seems to be confined to rocks except about the summits of the hills, while the other is sometimes seen on soil at no great elevation. In the West Highlands it is a good deal the more common of the two species.

Boulay in *Musc. de la France* II. p. 153 gives *G. obtusum* as a variety of *G. concinnatum*, but it is quite a distinct species, and any characters which might appear as if intermediate between the two are only superficial.

52. Gymnomitrium corallioides Nees

Gymnomitrium corallioides Nees, Eur. Leb. I p. 118 (1833).
Acolea corallioides Dum., Rec. d'obs. p. 23 (1835).
Cesia corallioides Carruth., Journ. Bot. p. 300 (1865).



1. Sterile branch. 2. Leaf. 3. Cells.

Dioicous. In dense *intricate*, white or greyish tufts *with tinge of dark grey or black*. Stems to 1·5 cm long, fragile, *much branched, sterile branches* simple, *arcuate, much compressed* and somewhat lanceolate. Leaves ·6-·7 mm long, *very densely imbricated* so as to be hardly visible, symmetrically appressed, broadly oval, very concave, *almost the whole leaf hyaline* and somewhat transparent, the *margin soon becoming disorganized* and erose; the young leaves *very shallowly bilobed*, sinus acute, lobes at first subacute with an acute projecting apical cell, but quickly becoming obtuse and rotundate through the destruction of the cells at the apex; marginal cells long, rectangular and thin-walled, the *next inner cells much smaller* with greatly and equally thickened walls, the cell cavity being *round or oval*, cells at middle of leaf 18–24 μ, oblong or oval, with less thickened walls but with large and frequently confluent trigones, cells at base larger with thin walls and small but frequently distinct trigones; *cuticle quite smooth*. ♀ inflorescence oval, on very short and slightly compressed branches; involucral bracts with margin *usually slightly reflexed* and distinctly and irregularly dentate, sinus acute, lobes *acute with a projecting terminal cell;* inner bracts irregularly lobulate and dentate. Capsule spherical, reddish-brown, valves broadly ovate, sometimes not separated to base; pedicel very short. Spores 14–16 μ, reddish-brown, minutely verruculose. ♂ bracts in several pairs, less closely imbricated than the leaves but similar in shape, squarrose at the apex; antheridia in pairs.

Hab. On rocks in the alpine region, rarely descending below 2800 ft. alt.

Distrib. Perthshire to Caithness, very rare. Fr. June–Aug.

The leaves are very closely imbricated in this species, and are difficult to dissect off the stem. The sinus and lobes can be detected only in the young leaves.

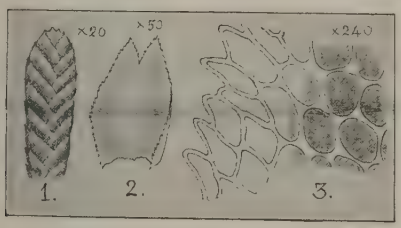
In addition to the notes given with *G. concinnatum*, the present plant can be distinguished from that species and from *G. obtusum* by its more numerous

branches, the small sub-marginal leaf-cells and the quite smooth cuticle, as well as by the different sinus and small lobes.

It is usually found on boulders, except on the summits of the hills, where, in common with the generality of alpine rock hepatics, it occurs on soil.

53. Gymnomitrium crenulatum Gottsche

Gymnomitrium crenulatum Gottsche ex Carr., Trans. Bot. Soc. Ed. p. 18 (1863); Gott. and Rabh., Hep. Eur. Exs. No. 478 (1871).
Cesia crenulata Carruth., Journ. Bot. p. 300 (1865).
Acolea crenulata Dum., Hep. Eur. p. 123 (1874).



1. Sterile branch. 2. Leaf. 3. Cells.

Dioicous. In *small*, dense, intricate patches, *reddish coppery* brown or sometimes olive-green, especially in shade. Stems to 1 cm long, *filiform*, *wiry*, much branched, sterile branches long, flexuose and *arcuate*, slightly compressed, of *nearly the same diameter throughout*, the apices subacute. Leaves *·28–·32* mm long, *very densely imbricated* so as to be hardly visible, symmetrically appressed, broadly ovate, very concave, the margin *narrowly hyaline*, $\frac{1}{5}$–$\frac{1}{4}$ bilobed, sinus acute, lobes triangular, acute, connivent, the *whole margin of the leaf markedly crenulate with a single row of elongated, nearly conical, hyaline cells*, the submarginal rows and those in the middle of the leaf 16–21 μ, rounded-oblong with thickened walls and angles; cuticle nearly smooth. ♀ inflorescence oval on a short branch; involucral bracts strongly involute, lobes crenulate, acute with a prominent terminal cell; inner bracts oblong, very tender. Capsule spherical, reddish-brown, the pedicel very slightly exserted. Spores 14–16 μ, minutely verruculose. ♂ bracts broader and more concave than the leaves but otherwise similar; antheridia usually single, ovate-globose, shortly pedicellate.

Hab. On rocks in the subalpine region, seldom ascending into the alpine to 2500 ft. alt.

Distrib. Dartmoor and Wales to Caithness, frequently common but almost confined to the west; Ireland. Fr. June–Aug.

Does not bear any resemblance to the other species of the genus. The stems are like thin wire, the sterile ones rather acute and arcuate-decumbent and the plant is of a reddish coppery colour. The hyaline margin of the leaves can be seen with the lens; under the microscope these marginal cells are seen to be elongated and conical. It is a much smaller plant than any of the preceding. It always occurs on rocks or boulders, never on soil, and usually forms small patches of an inch or more across. It is a subalpine rather than an alpine species, and is very rare except on the west side of the British Isles.

The forma *rubescens* Bryhn is the common form of the type. The greenish colour which the plant sometimes assumes, is owing to its being in shade or occasionally to the rock being less dry than usual; but, in common with the preceding species, it is nearly always found on rocks which are dry.

This species is sometimes mistaken in the field for *Marsupella Stableri*, but it grows in more compact patches, is larger, the stems arcuate, and the leaves more closely imbricate. Under the microscope they are quite different.

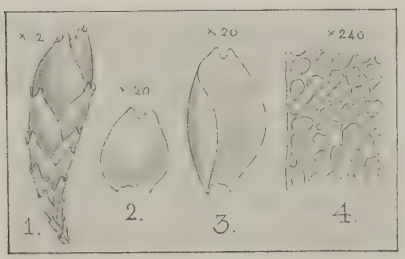
Subgen. Homocraspis (Lindb.) K. Müll.

Homocraspis Sect. Lindb. 1886; Schiffn. in Engl. and Prantl. I 3 p. 77 (1893).
Homocraspis K. Müll., Rabh. Krypt. Fl. p. 415 (1909).

Plant brown. Leaves not very closely imbricate, the margin and apex not hyaline.

54. Gymnomitrium adustum Nees

Gymnomitrium adustum Nees, Eur. Leb. I p. 120 (1833).
Cesia brevissima Pears., Hep. Brit. Isles p. 399 (1901).
Marsupella olivacea Spruce, Rev. Bryol. p. 97 (1881); Pears., Hep. Brit. Isles p. 380 (1901).



1. Fertile stem. 2. Leaf. 3. Involucral bract. 4. Leaf-cells.

Paroicous. In small blackish-brown or olive-green patches on rocks or in larger patches on soil. Stems *2–3* mm long, irregularly branched, the branches mostly from near the base of the stem and usually simple and *erect* or ascending; rhizoids violet or colourless, rather plentiful except in the upper part of the branches. Leaves ·35 mm long, slightly accrescent in the sterile stems, *suddenly and greatly so in the fertile stems*, subimbricate, *oval*, concave, $\frac{1}{5}$ bilobed, the lobes triangular, inflexed, *obtuse*, *sinus obtuse;* cells 8–12 μ, rounded-quadrate, walls strongly and nearly equally thickened, trigones thus being indistinct. ♀ branch clavate; involucral bracts large, ·6–·63 mm long, triangular-rotundate, very concave, $\frac{1}{7}$–$\frac{1}{8}$ bilobed, *sinus and lobes obtuse*, cells 10–14 μ, with strongly and almost equally thickened walls; inner bracts generally lobed and dentate. Capsule reddish-brown, pedicel to 1 mm long or only very slightly exserted. Spores 8–12 μ, pale reddish-brown, nearly smooth. Elaters quadrispiral. Antheridia 1–2, oval.

Hab. On rocks in the subalpine region, also on soil in the alpine, ascending to 4400 ft. alt.

Distrib. Wales and Westmoreland to Aberdeen, frequent in the Highlands, rare elsewhere. Fr. May–Oct.

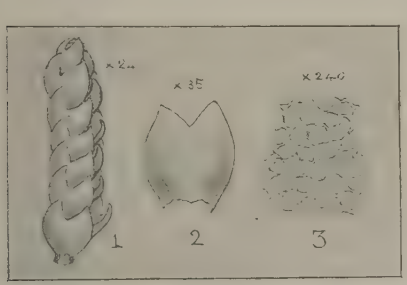
Is more likely to be confused with the equally paroicous *Marsupella ustulata* and *M. Sprucei* than with any *Gymnomitrium*, but these have leaves with acute lobes with usually an acute sinus and *M. Sprucei* has considerably larger cells. Even if the student should have difficulty in dissecting the bracts, which also differ from those of the two others, there is little in noting the position of the sterile archegonia on the calyptra which is characteristic of this genus as distinct from *Marsupella*, as far at least as it refers to the species in question.

When *G. adustum* occurs on rocks it forms smaller tufts and of a lighter colour than when on soil.

The closely related *G. andreaeoides* (Lindb.) K. Müll., which is found in western Norway, should be looked for on wet rocks on our hills. It is rather larger than *G. adustum*, distinctly glistening when moist; the margins of the leaves, especially at the lobes, are much incurved and the cells are rather larger.

55. Gymnomitrium varians (Lindb.) Schiffn.

Nardia varians Lindb., Musc. Scand. p. 9 (1879).
Cesia varians Lindb., Meddell. Soc. F. Fl. Fenn. 13 p. 238 (1886).
Sarcoscyphus confertus Limpr., Jahresb. Schles. Ges. Vaterl. Cult. 57 p. 312 (1886).
Gymnomitrium varians Schiffn. in Engl. and Prantl. I 3, p. 77 (1893).
Cesia conferta Pears., Hep. Brit. Isles p. 397 (1901).
Acolea conferta Lett., List Spec. Hep. Brit. Isles p. 181 (1902).



1. Barren stem. 2. Leaf. 3. Cells.

Polyoicous. In dense patches or occasionally loosely tufted among mosses, reddish brown to nearly black. Stems 4–7 mm long, irregularly branched, frequently innovant, branches *erect* or suberect; *rhizoids scarce* except at base of stem. Leaves slightly accrescent, rather densely imbricated on the fertile stems, *erecto-patent*, concave, ·5 mm long, *broadly oval*, $\frac{1}{4}$–$\frac{1}{5}$ bilobed, *sinus acute* or subacute, lobes ovate-triangular, subacute, slightly incurved; cells 14–18 μ, walls somewhat thickened, trigones large, distinct. ♀ inflorescence not conspicuous; involucral bracts much broader and more concave than the leaves and less deeply lobed, the lobes sometimes apiculate; inner bracts oblong. Capsule oval-globose, dark brown, pedicel

1·5 mm long. Spores 8–12 μ, pale reddish-brown, nearly smooth. Elaters 70–120 μ long, frequently branched, 3–4-spiral. ♂ inflorescence below the ♀, *or on separate branches*, or on different plants; bracts in several pairs, subrotund with frequently an obtuse lobe-like tooth on the antical side; antheridia 1–2, oval, on a pedicel of almost equal length and two cells thick.

HAB. On bare moist soil in the alpine region from 2800-4400 ft. alt.

DISTRIB. West and East Inverness to Forfar, frequent on some of the highest hills. Fr. June–Aug.

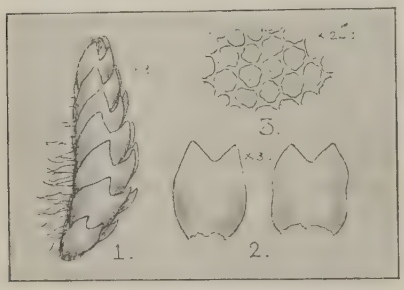
Forms extensive patches on moist soil about the summits of our higher mountains. Various species with much the same appearance are found in these situations, as *G. crassifolium*, *G. adustum*, *Marsupella ustulata*, *M. Sprucei* and *M. condensata*. The present species is perhaps the most frequent of these in large patches, and it is the only one which has at any time a monoicous inflorescence. Its inflorescence varies considerably, especially are paroicous plants not at all uncommon, and it is also sometimes apparently dioicous or at least what Schiffner terms pseudo-dioicous, where only ♂ or ♀ inflorescence can be found, but where this may be owing to the separation of the branches, which bear the inflorescence, from the parent stem.

G. adustum has small, oval leaves, much narrowed at the apex, with rounded sinus and lobes and smaller cells; the fertile stems are also suddenly clavate.

The leaves on the sterile stems are frequently nearly patent and rather laxly placed, especially when the plant is growing among such mosses as *Dicranum*.

56. Gymnomitrium crassifolium Carr.

Gymnomitrium crassifolium Carr., Trans. Bot. Soc. Ed. XIII. p. 461 (1879).
Cesia crassifolia Lindb., Meddel. Soc. F. Fl. Fenn. 14 p. 48 (1888).
Acolea crassifolia Steph., Spec. Hep. II p. 11 (1901).



1. Barren stem. 2. Leaves. 3. Cells.

Dioicous. In dense, dark reddish-brown to almost black patches. Stems to 6 mm long, irregularly branched, the branches *decumbent-arcuate* or sub-erect; rhizoids long, *numerous to near apex of stem.* Leaves ·42-·5 mm long, of *thick* texture, imbricate, erecto-*secund*, *ovate-quadrate*, $\frac{1}{5}$ bilobed, *sinus rather obtuse* and forming *almost a right angle*, lobes broadly triangular, subacute, slightly inflexed; cells 14–18 μ, rounded-quadrate, the walls thick,

trigones large. ♀ inflorescence little prominent, obovate; involucral bracts involute, much broader than the leaves and less deeply lobed; inner bracts lobate-dentate. Capsule globose, dark brown; pedicel 1·5–2 mm long. Spores 8–10 μ, pale reddish-brown, smooth. Elaters 70–105 μ long and 8–9 μ broad, occasionally branched, reddish-brown, 3–4-spiral. ♂ inflorescence oblong, truncate, bracts in several pairs, closely imbricated, larger than the leaves and more concave; antheridium generally solitary, oval, on a pedicel of nearly equal length.

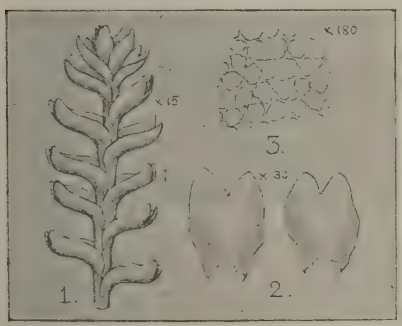
HAB. On bare moist soil in the alpine region from 3000–4400 ft. alt.

DISTRIB. West Inverness to Aberdeen, rare.

Apart from the inflorescence, the characters which separate this plant from *G. varians* are so slight and inconstant as to be practically negligible, and it was only on finding the inflorescence to be dioicous that specimens were placed with some certainty to the present plant. Moreover, Schiffner has recently pointed out, in his *Krit. Bemerk.* to Series VII of the *Hep. Eur. Exs.*, the possibility of *G. crassifolium* being pseudo-dioicous in a manner resembling that of *G. varians*, and in this way the limits between the two plants would disappear. Further investigation is necessary, but the rather unsatisfactory solution at present appears to be, at least as far as northern Europe is concerned, that where a paroicous or monoicous inflorescence can be distinguished with certainty, the plant is placed to *G. varians*; if these cannot be distinguished, it is placed to *G. crassifolium*.

57. Gymnomitrium alpinum (Gottsche) Schiffn.

Sarcoscyphus alpinus Gottsche in Gott. & Rabh., Hep. Eur. Exs. no. 535 (1872).
Cesia alpina Lindb., Meddell. Soc. F. Fl. Fenn. 13 p. 251 (1886).
Marsupella alpina Bernet, Cat. Hép. Suisse p. 29 (1888).
Gymnomitrium alpinum Schiffn. in Engl. & Prantl. I 3 p. 77 (1893).



1. Barren stem. 2. Leaves. 3. Cells.

Dioicous. In dense reddish-brown to almost black, rather *shining* tufts. Stems 1·5–3 cm long, filiform, denudate at base, decumbent or suberect, simple or with a few long branches, innovating from below the ♀ inflorescence; rhizoids few, *mostly violet* coloured. Leaves ·5–·6 mm long, *of equal size throughout*, distant when moist, imbricate when dry, *patent or almost at right angles to the stem from an erect, narrowed, sheathing*

decurrent base, concave, oval-rotund, $\frac{1}{3}$–$\frac{1}{4}$ bilobed, sinus *acute*, or occasionally rather obtuse, *lobes* triangular-ovate, *obtuse*, slightly *incurved*, *margin of leaf plane*, narrowly hyaline; cells 10–14 μ, of nearly equal size throughout, rounded-oval, strongly thickened at the angles, the trigones being large and frequently confluent. ♀ inflorescence ovate; involucral bracts large, very concave, $\frac{1}{6}$–$\frac{1}{5}$ bilobed, lobes obtuse; inner bracts small, oblong. Capsule spherical, dark brown. ♂ plant more slender, bracts in 4–5 pairs, closely imbricate, larger than the leaves, navicular-concave; antheridia 2–3, oval-globose, on a pedicel of half their length.

var. **heterophyllum** Bernet, Rev. Bryol. p. 47 et 62 (1885).

Tufts decumbent with many widely spreading stolons having the leaves mostly small and appressed or nearly so and not decurrent.

Hab. On rocks, especially granite, in the upper subalpine and the alpine regions to 4300 ft. alt., rarely descending below 1400 ft. alt.

Distrib. Wales and Westmoreland to Banff, rare. Var. *heterophyllum*, Argyll; West Inverness.

Quite different in appearance from the other species of the genus. It is larger, and the leaves when moist are nearly at right angles to the stem. The shining leaves, not increasing in size towards the apex of the filiform stem, together with the obtuse lobes, acute sinus and the sheathing base, render it not difficult to recognise. It is confined to rocks. The leaf cells are almost of the same size throughout. In the old leaves the margin sometimes becomes disorganized and appears as if spinous-dentate. ♂ and ♀ plants are common, but I have not seen fruit in Britain. Several perichaetia are usually seen on a stem. The plant is most commonly found with us in rather lax decumbent tufts, seldom densely compact.

Marsupella Funckii grows on soil, the leaves are not decurrent, the lobes are generally acute and the cells distinctly larger. The *M. emarginata* group have some of the leaves, at least, with reflexed margins. The *M. sphacelata* group are found in wet or moist ground and the stem has larger hyaline cortical cells. *M. sparsifolia* is paroicous. All these have, in addition, much larger leaf-cells and can readily be distinguished by this.

This species has sometimes been considered to be a *Marsupella*, but it belongs to this genus.

XXI. MARSUPELLA Dum.

Nardius S. F. Gray, Nat. Arr. Brit. Pl. 2 p. 694 (1821).
Marsupella Dum., Comm. Bot. p. 114 (1822).
Sarcoscyphus Corda in Opiz, Beitr. 1 p. 652 (1829).
Nardia Carr., Trans. Bot. Soc. Ed. X p. 309 (1870).

Plants large to very small, usually densely caespitose and commonly brown in colour. Stems simple or sparingly branched, with few rhizoids, stoloniferous towards the base. *Leaves equally bilobed, transverse, complicate-concave*, usually patent. Underleaves absent. Inflorescence terminal. Involucral bracts erect, larger than the leaves, more or less highly *connate at their base and also with the perianth*. *Perianth immersed*, broadly obconic to ovate, the free apex conical and 4–6 lobed after the exsertion of the capsule. Calyptra surrounded *at its base* by the sterile archegonia. Capsule globose, the walls of two layers of cells, the inner with or without semi-annular thickenings. Elaters 2–4-spiral. Gemmae unknown.

All the following species belong to the subgenus *Eumarsupella*, with the characters as above. The subgenus *Hylacme* Lindb., Meddel. Soc. F. Fl. Fenn. 13 p. 238, 1886, containing the solitary species, *M. apiculata* Schiffn., has the habit of *Eugymnomitrium*, the leaves closely imbricated and with hyaline margins.

1 { Leaves distant, scale-like; on wet alpine rocks ..... *59. nevicensis*
{ Leaves approximate or imbricate, not scale-like 2

2 { Stems 2–7 cm or more in length; dioicous 3
{ Stems 3–10 mm, rarely to 20 mm, in length; dioicous or paroicous 8

3 { Ant. margin of leaf more or less recurved, leaves divided to $\frac{1}{2}$ or less.....4
Ant. margin not recurved, leaves divided to $\frac{1}{3}$ or more.....6

4 { Leaves dull, $\frac{1}{5}$–$\frac{1}{8}$ bilobed, lobes angular .....*65. emarginata*
Leaves dull or shining, $\frac{1}{8}$–$\frac{1}{10}$ bilobed, rotundate, lobes rounded.....5

5 { Tall, usu. submerged ; leaves dull, patent .....*67. aquatica*
Shorter, not submerged ; leaves shining when dry, erecto-patent, sinus often hardly apparent, cells guttulate.....*66. Pearsonii*

6 { Aquatic, very flaccid ; leaves dull green with the tips of the uppermost brown 68. *sphacelata*
Not aquatic nor flaccid ; leaves brown.....7

7 { Leaves broadly rotund-cordate, broadest below the middle...*70. Jörgensenii*
Leaves obcordate, broadest above the middle ; cells larger....*69. Sullivantii*

8 { Dioicous 9
Paroicous 12

9 { Sinus lunate, shallow, lobes small, incurved .....*58. condensata*
Sinus acute, deeper.....10

10 { Stems filiform, leaves not imbricated, nearly appressed to stem, sinus and lobes very acute ; usu. in rosy purple layers on alpine rocks...*60. Stableri*
Stems stouter, leaves imbricate, erecto-patent ; in dark or yellowish-brown patches on soil or on rocks 11

11 { Ant. margin of leaf more or less recurved ; lobes rather obtuse or apiculate *65. emarginata*
Margin never recurved ; sinus deeper, more acute, lobes acute ...*64. Funckii*

12 { Plant 10–25 mm ; leaves patent, rather remote, lobes rather obtuse *61. sparsifolia*
Much smaller ; leaves erecto-patent, imbricate, lobes acute.....13

13 { Bracts cordate at base, lobes obtuse ; leaf-cells 12–18 μ in diam. *63. ustulata*
Bracts not cordate at base, lobes acute ; leaf-cells 18–23 μ in diam *62. Sprucei*

58. Marsupella condensata (Ångstr.) Kaal.

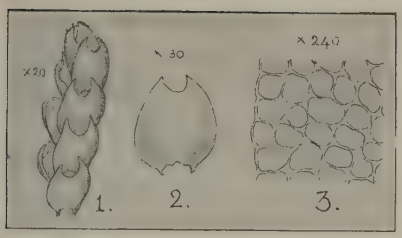
Gymnomitrium condensatum Ångstr. in Hartm., Skand. Fl. ed. 10, 2 p. 128 (1871).

Sarcoscyphus aemulus Limpr., Jahresb. Schles. Ges. Vaterl. Cult. 58 p. 183 (1881).

Marsupella aemula Lindb., Meddel. Soc. F. Fl. Fenn. 13 p. 238 (1886).

Marsupella condensata Kaalaas, Vidensk. Skr. 1 No. 9 p. 22 (1898).

Dioicous. In extended low reddish-brown to dark brown patches, thickly matted below. Stems ·5–2 cm long, *filiform*, pale brown, with several *erect branches* and *long innovations*, the ♀ branches clavate, the innovations more slender ; rhizoids colourless, numerous in the older parts, scarce on the innovations. Leaves rotund-ovate, very concave, *not much imbricate*, smaller and rather distant at



1. Part of stem. 2. Leaf. 3. Cells.

the base of the ♀ branch, increasing in size upwards and imbricate towards the inflorescence, on the innovations generally small and *often absent at the base*, becoming slightly larger upwards; *leaves slightly antically secund*, $\frac{1}{4}$-$\frac{1}{5}$ bilobed, *sinus lunate*, lobes triangular, acute, incurved; cells 12–15 μ, rounded-hexagonal, walls considerably thickened, especially at the angles, the trigones being usually large and distinct, but sometimes indistinct; cuticle smooth. ♀ inflorescence prominent, bracts very concave, connivent, much larger than the leaves and very broad, $\frac{1}{6}$ bilobed, sinus generally *lunate*, lobes acute or apiculate; cells large, 17–21 μ, with distinct trigones. "Perianth about $\frac{1}{4}$–$\frac{1}{3}$ adnate to the bracts, free and conical above, somewhat compressed from the back, reaching $\frac{2}{3}$–$\frac{3}{4}$ the height of the bracts, somewhat incurved at the rather wide, tender mouth, the apex somewhat regularly crenulate-dentate. Spores smooth, reddish-brown, 10 μ, elaters 7–7·5 μ thick, bispiral." (Schiffner). ♂ plant resembling the sterile, bracts rather larger than the leaves, saccate at base, in few pairs at the apex of a branch. Antheridia 3–4.

Hab. On bare moist soil in the Alpine region from 3200ft. alt. upwards.

Distrib. Ben Lawers and Ben Nevis, rare.

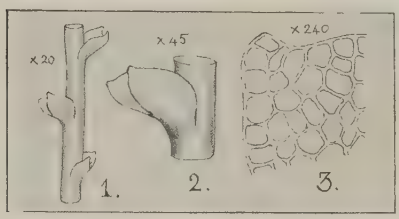
This small plant is not likely to be mistaken, as its lunate sinus does not occur in our other species. *Gymnomitrium adustum* has an obtuse sinus when flattened out, but not lunate, and the lobes are obtuse.

Mars. apiculata Schiffn. will most probably be found on some of our highest hills. It frequently grows with *M. condensata* and greatly resembles it in appearance. It differs in having the leaves very closely imbricated, the sinus not lunate but angled at base, the lobes with an apiculus of 1–2 hyaline cells, but which may be destroyed in the older leaves, the margin of leaf, at least in the younger parts, with a 1–2-celled row of empty hyaline cells, and the involucral bracts with a broad hyaline and crenulate border.

59. Marsupella nevicensis (Carr.) Kaal.

Jungermannia nevicensis Carr., Trans. Bot. Soc. Ed. XIII p. 464 (1879).
Sarcoscyphus capillaris Limpr., Jahresb. Schles. Ges. Vat. Cult. p. 182 (1880).

Hygrobiella nevicensis Spruce, On Ceph. p. 77 (1882).
Nardia latifolia Lindb., Meddel. Soc. F. Fl. Fenn. (1882).
Marsupella nevicensis Kaalaas, Nyt Mag. Naturw. xxxiii, 5, p. 417 (1893).



1. Part of stem. 2. Leaf. 3. Cells.

Dioicous. In loose spreading low patches of a *green or reddish* colour on *wet* rocks. Stems 1–2 cm long, *filiform*, suberect, flexuous, sometimes *arcuate* in the upper part, simple or sparingly branched, with a few descending flagella, frequently dark red above, ·12–·16 mm in diam. and 9–11 cells across, cortical layer of cells *large*, *hyaline*, thin-walled, internal cells smaller with thickened walls, *the whole plant almost entirely without rhizoids*, which however when present are short and colourless, rarely violet. Leaves absent at base of stem, *squamiform and appressed* above this, so as to be hardly visible but frequently destroyed, slightly increasing in size upwards and erecto-patent, concave, *very distant*, rotund-ovate, about 1·5 times the breadth of the stem, ·21–·38 mm long, $\frac{1}{4}$ to nearly $\frac{1}{2}$ bilobed, sinus acute, *lobes broad*, acute or subacute, *frequently incurved;* cells 13–16 μ, rounded-hexagonal, sometimes rectangular at the margin, the walls *slightly* thickened, trigones more or less distinct; cuticle smooth. ♀ inflorescence with 1–3 innovations, prominent, ovate, bracts in two pairs, usually broader than long, cordate at base, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, sinus acute, lobes acute and apiculate; cells 14–21 μ with distinct trigones.

Hab. On wet alpine rocks.

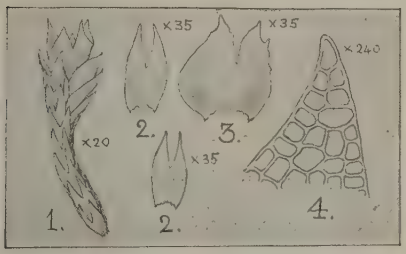
Distrib. Ben Nevis, very rare.

This species, as it occurs in Britain, does not bear any resemblance to the other members of the genus or of *Gymnomitrium*; it is more likely to be mistaken in the field for a *Cephaloziella*. The succulent stems and almost entire absence of rhizoids from every part of the plant will distinguish it from other small alpine species. Characters also to be noted are the stoloniferous habit and transverse leaves which it has in common with the other species of *Marsupella*, and the very distant, concave leaves with their frequently incurved apex of lobes and the thin cell-walls. On very wet or shaded rocks the plant is green, but on exposed and rather drier rocks it has a pale reddish colour, at least in the upper parts.

Our plant is identical with some Norwegian specimens. Prof. Schiffner, to whom I sent specimens from the original locality on Ben Nevis, remarked that it was the form nearest the var. *irrigua* of *Sarcoscyphus capillaris* Limpr. Only sterile ♀ inflorescence has been found in Britain.

60. Marsupella Stableri Spruce

Marsupella Stableri Spruce, Rev. Bryol. p. 89 et 96 (1881); Pears., Hep. Brit. Isles p. 386 *pl.* 170 (1901).
Marsupella Boeckii Macv. *non* Lindb. ? Journ. Bot. p. 117 (1905).



1. Part of stem. 2. Leaves. 3. Bract. 4. Cells.

Dioicous. In small intricate patches on rocks, *rosy-purple*, less frequently brownish-green in colour. Stems to 1 cm long, *suberect or prostrate*, filiform, with microphyllous flagella, innovant-proliferous; rhizoids colourless, scarce. Leaves small, distant at the lower part of the stem, subimbricate above, ·16–·24 mm long, *complicate*, *appressed*, ovate-quadrate, $\frac{1}{3}$ to nearly $\frac{1}{2}$ bilobed, *sinus very acute*, lobes narrowly *triangular-lanceolate*, acute; cells 14–17 μ, rounded-hexagonal, the walls equally thickened or nearly so; cuticle smooth but frequently appearing as if papillose at the apex of the branches through disorganisation of the margin. ♀ inflorescence prominent, bracts in 2–3 pairs, *suddenly* much larger than the leaves; involucral bracts broadly ovate, shortly connate, $\frac{1}{5}$–$\frac{1}{3}$ bilobed in the mature plant, sinus acute, lobes acute or sometimes apiculate, margin entire, *sinuate*, *or somewhat dentate*, cells 16–21 μ, trigones sometimes distinct. Perianth slightly shorter than the bracts and $\frac{1}{2}$–$\frac{3}{4}$ connate with them, the mouth narrow and crenulate with long cells. Capsule subglobose, pedicel short. ♂ inflorescence in the middle or apex of the stem, prominent, bracts in few pairs, much larger than the leaves, greatly ventricose, $\frac{1}{3}$ bilobed, lobes acute. Antheridia generally solitary, large, oval-globose, on a short pedicel.

Hab. On steep, moist rocks in the upper subalpine and alpine regions from 1400–3600 ft. alt.

Distrib. Wales and Westmoreland to Aberdeen, rare and almost confined to the west.

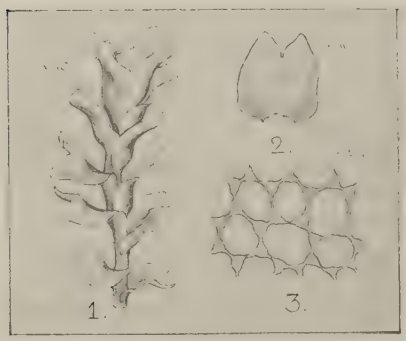
The rosy-purple of this minute species will alone separate it from any other British *Marsupella*. The small, appressed leaves with almost lanceolate lobes are also unlike the other species. It is sometimes confused with *Eremonotus myriocarpus*, but that plant has the leaves more deeply divided, the cells quadrate and incrassate, and the bracts and perianth are quite different; the colour is also reddish-brown instead of being rosy-purple.

Sterile plants of any of our *Cephaloziellae* can hardly be mistaken for this plant. None of them have appressed leaves or of the same shape, several have underleaves, rhizoids are generally numerous, etc.

I formerly considered this species to be the same as *M. Boeckii* Aust. from Norway, but specimens of that plant from the original locality have less deeply divided leaves and broader, less pointed lobes. It is still, however, I consider, a matter of much doubt whether they are distinct species; and the geographical distribution of the two is anomalous if they are so, as all our other alpine species which reach a high altitude are found in Norway, and almost all the alpine species which occur in Western Norway are found in Britain.

61. Marsupella sparsifolia (Lindb.) Dum.

Sarcoscyphus sparsifolius Lindb., Not. pro F. Fl. Fenn. förh. 9 p. 280 (1868).
Marsupella sparsifolia Dum., Hep. Eur. p. 128 (1874).
Sarcoscyphus styriacus Limpr., Jahresb. Schles. Ges. Vaterl. Cult. 58 p. 180 (1881).



1. Part of stem. 2. Leaf. 3. Cells.

Paroicous. In *purple-brown to nearly black* patches, rarely pale in colour. Stems ·5–1·5 cm long, erect, simple or with few branches, frequently repeatedly innovant from below the inflorescence; rhizoids colourless or pale rose, scarce. Leaves *somewhat distant*, slightly shining, of nearly the same size throughout, *patent or almost squarrose* to erecto-patent, *cordate*-ovate, half embracing the stem, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, sinus acute, open, *lobes broadly ovate*, *usually obtuse* but sometimes subacute; cells 18–24 μ, rounded-hexagonal, trigones rather large, *distinct*. Bracts resembling the leaves, but larger, the subinvolucral bracts with acute or obtuse lobes, antheridia 2–3, oval, the involucral bracts connate to near the middle, lobes acute. Perianth oblong-ovate, connate with the bracts for $\frac{1}{4}$ its length. Capsule spherical. Spores 12–15 μ, brown, minutely granulate.

Hab. On alpine granite rocks.

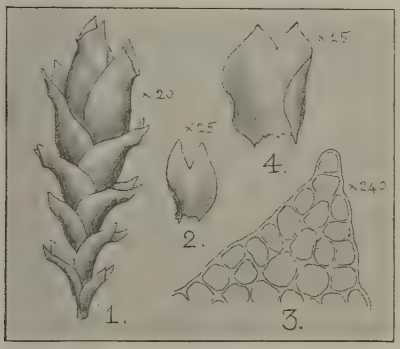
Distrib. Lochnagar, Aberdeenshire, 1876 *(J. & T. Sim)*.

This rare species has been found only in one locality in Britain. It varies greatly in size on the Continent. The Scottish plant bears a good deal of

resemblance to small forms of *M. Sullivantii* or *M. Jorgensenii*. It differs from these in its paroicous inflorescence, the leaves more distant, the lobes generally only obtuse and not rarely even subacute, while in the others the lobes are as a rule rotundate. It is two to three times as large as the equally paroicous *M. ustulata* and *M. Sprucei*, and it has more distant leaves which are also semiamplexicaul, cordate at base and with the lobes more obtuse; also the cells are larger than in *M. ustulata* and it is less rigid and of a blacker colour than either of them.

62. Marsupella Sprucei (Limpr.) Bernet

Sarcoscyphus Sprucei Limpr., Jahresb. Schles. Ges. Vaterl. Cult. p. 179 (1881).
Marsupella Sprucei Bernet, Cat. Hép. Suisse p. 33 (1888).



1. Fertile stem. 2. Leaf. 3. Cells. 4. Bract.

Paroicous. In purple-brown to nearly black patches, similar in appearance to *M. ustulata*. Fertile stems 2–3 mm long, suberect, nearly always simple and rarely with innovations, stolons more numerous than in that species, leaves more closely imbricate and *gradually* increasing in size, thus *gradually clavate*, broadly ovate, ¼ bilobed, sinus acute, lobes acute or subacute; cells *larger*, *18–20 μ*; sterile stems to 4 mm long, sometimes rather numerous, frequently branched, leaves subimbricate or distant, *minute*, about *equalling in length the diameter of the stem*, or slightly longer, *erecto-appressed* to appressed, sinus narrow, acute, lobes acute. Subinvolucral bracts much larger than the leaves, rotund-quadrate, *not cordate at base*, sinus acute or obtuse, *lobes acute*; involucral bracts connate to ⅓ or higher, sinus usually acute, *lobes acute*. Capsule, spores and elaters as in *M. ustulata*.

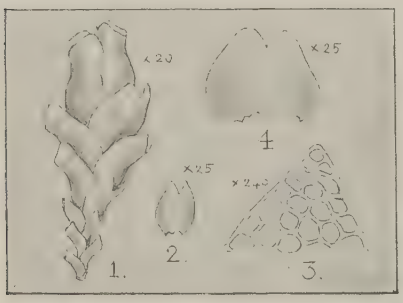
HAB. Similar to *M. ustulata*.

DISTRIB. Wales and West Inverness to Aberdeen. Fr. May–Oct.

This species has until recently been confused with *M. ustulata*, from which it can be distinguished only by the microscope. The italicized characters will serve for this purpose, especially the involucral bracts and the different size of the leaf-cells. Both species grow on soil as well as on rocks. The distribution of the present plant is very imperfectly known as yet, but *M. ustulata* appears to be much the more common of the two in the subalpine region at least.

63. Marsupella ustulata Spruce

Jungermannia ustulata Hüben., Hep. Germ. p. 132 (1834). ?
Nardia adusta Carr., Brit. Hep. p. 20 (1874).
Marsupella ustulata Spruce, Revue Bryol. p. 100 (1881).



1. Fertile stem. 2. Leaf. 3. Cells. 4. Bract.

Paroicous. In broad purple-brown to nearly black patches on soil, or in small tufts on rocks. Stems *2–5 mm* long, sub-erect, simple or with a few branches, sometimes innovating from below the inflorescence; rhizoids colourless and numerous. Leaves on the sterile stems, and on the lower part of the fertile, little imbricate, erect or *erecto-patent*, *twice as broad as the stem*, ·31–·40 mm long, broadly oval, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, sinus acute, rectangular, lobes acute or sub-acute; cells *12–18* μ, considerably and almost equally thickened, trigones seldom distinct, except on the bracts. ♀ branch clavate, subinvolucral bracts *rather abruptly* much larger and broader than the leaves, *cordate* at base, $\frac{1}{8}$–$\frac{1}{5}$ bilobed, sinus acute, lobes usually *obtuse*, antheridia 2–3, oval, on a pedicel of equal length, involucral bracts $\frac{1}{3}$ or more connate, *lobes most frequently obtuse*. Perianth much shorter than the bracts and $\frac{1}{3}$ connate with them, ovate, the mouth small, crenulate. Capsule spherical, reddish-brown, without semi-annular thickenings. Spores 9–12 μ, pale reddish-brown, nearly smooth. Elaters bispiral, reddish-brown, nearly equalling the spores in breadth.

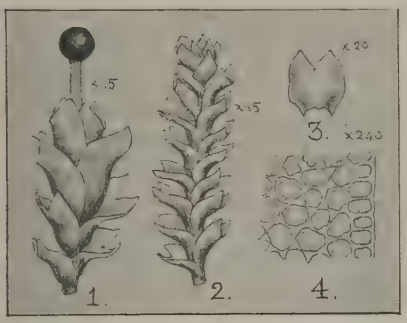
Hab. On rocks and moist soil in the subalpine and alpine regions ascending to 3900 ft. alt.

Distrib. N. to Inverness, rare except in the Highlands. Fr. June–Oct.

This species and *M. Funckii* are the two most generally distributed small members of the genus at low elevations. They are hardly likely to be confused with one another as *M. ustulata* is paroicous and its inflorescence is almost always present; it is also a smaller plant and occurs generally only as small tufts on rocks when on the low ground, while *M. Funckii* is confined to soil, where it forms large, compact patches; the latter is also somewhat glistening and with larger leaf-cells. Very immature states of *M. emarginata* with acute lobes, which might possibly be mistaken for this species, are sterile, the antical margin of some of the leaves is reflexed, and the cells are larger.

64. Marsupella Funckii (Web. et Mohr) Dum.

Jungermannia Funckii Web. et Mohr, Bot. Tasch. p. 422 (1807).
Sarcoscyphus Funckii Nees, Eur. Leb. I p. 135 (1833).
Marsupella Funckii Dum., Rec. d'obs. p. 24 (1835).
Nardia Funckii Carr., Brit. Hep. p. 17 (1874).



1. Fertile stem. 2. Sterile stem.
3. Leaf. 4. Cells.

Dioicous. In extended greenish-brown to purple-black patches *on soil.* Fertile stems 3–5 mm long, erect, simple or with few branches, erecto-patent, increasing in size upwards to the rather abruptly clavate inflorescence; sterile stems to 15 mm long, erect, frequently incurved at the apex, leaves *patent, nearly at right angles to stem*, of equal size throughout, sometimes absent at the base, subrotund, $\frac{1}{3}$ to nearly $\frac{1}{2}$ bilobed, *sinus acute* but frequently rounded at the base, *lobes triangular, acute* or subobtuse and generally incurved at apex, *margins plane*; cells 14–18 μ, rounded hexagonal, *strongly thickened at the angles.* Involucral bracts much larger than the leaves, $\frac{1}{4}$ connate, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, sinus acute, *lobes acute* or subobtuse. Perianth shorter than the bracts and connate with them for $\frac{1}{2}$ its length. Capsule nearly spherical, dark brown, without semi-annular thickenings. Spores 7–9 μ, pale brown, nearly smooth. Elaters 7–9 μ broad, bispiral, reddish-brown. ♂ bracts in two or more pairs at the apex of the stem, ventricose, larger than the leaves. Antheridia oval, generally in pairs.

Hab. On moist soil on stony footpaths and old roads in the lower subalpine region, rarely ascending above 1000 ft. alt.

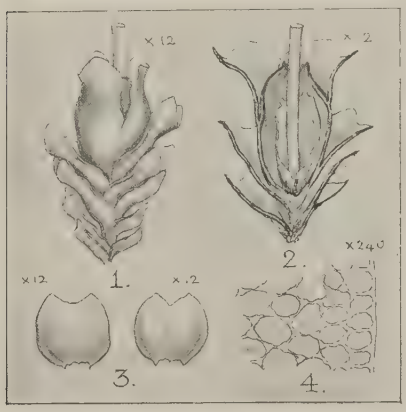
Distrib. N. to Rosshire, uncommon; Ireland. Fr. March–July.

Is sometimes confused with small forms of *M. emarginata*, which grows in similar places, as on the side of old roads; the present species is smaller than almost any form of that plant, the leaves more pectinate-distichous, more deeply lobed, the lobes more acute, the antical margin never reflexed and the cells considerably smaller. The dioicous inflorescence will separate it from any other small species likely to be mistaken for it, and its being dioicous is generally seen without difficulty, as the capitate ♂ bracts and the interrupted appearance lower down the stem caused by the old bracts are conspicuous.

This species varies a good deal in size. Nees in *Eur. Leb.* I p. 135 gives two forms α *major* and β *minor*, both of which are found in Britain.

65. Marsupella emarginata (Ehrh.) Dum.

Jungermannia emarginata Ehrh., Beitr. p. 80 (1788).
Jungermannia macrorhiza Dicks., Plant. Crypt. Fasc. 2 p. 16 *pl.* 5 fig. 10 (1790).
Marsupella emarginata Dum., Comm. Bot. p. 114 (1822).
Sarcoscyphus Ehrharti Corda in Sturm, Fl. Germ. II, 19 p. 25 (1830).
Nardia emarginata Lindb., Hep. in Hib. lect. p. 531 (1875).



1. Fertile stem. 2. Section through do. 3. Leaves. 4. Cells.

Dioicous. In extended dull green to *brown* or *reddish*-brown patches. Stems 2–4 cm long, or more, firm, erect or suberect, usually simple, frequently innovating from below the ♀ inflorescence, cortical layer of cells usually *with thick walls* of about the same size as the internal cells; rhizoids colourless or occasionally tinged with violet, almost confined to the stolons and base of the stems. Leaves approximate, subimbricate above, semi-amplexicaul, *erecto-patent*, patent or nearly horizontal, of nearly equal size throughout, quadrate-rotund, $\frac{1}{5}$–$\frac{1}{6}$ bilobed, sinus broad, obtuse, lobes obtuse or *obtusely pointed*, the antical margin *reflexed*; cells 18–24 μ, rounded hexagonal, smaller and oblong near the margin, the walls usually only slightly thickened, trigones distinct. Involucral bracts erect, larger than the leaves, connate to the middle, sinus and lobes almost similar to those of the leaves. Perianth slightly shorter than the bracts and connate with them to above the middle, the free portion 4–6 lobed. Capsule oval-globose, brown, inner layer of wall with semi-annular thickenings. Spores 10–13 μ, reddish-brown, finely granulate. Elaters bispiral, reddish-brown. ♂ bracts in 3–4 pairs, imbricate, ventricose, sinus and lobes frequently acute, the antical margin broadly reflexed. Antheridia 3–5, oval, longly pedicellate.

Hab. On moist rocks and on soil in the lower subalpine region and almost confined to rocks in the upper subalpine and alpine regions, ascending to 3600 ft. alt.

Distrib. N. to Shetland, rare in the drier districts, very common in the wetter hilly districts except when calcareous; Ireland. Fr. Feb.–July.

The species of the *M. emarginata* group, which includes the two following plants, are firmer than those of the *M. sphacelata* group and never have the purple-black or scorched appearance which the latter generally have. They can always be known from them and from our other species of the genus by the antical margin of the leaves being more or less reflexed; this is not seen in every leaf and is sometimes only slight in small forms of the present plant, but it can always be noted here and there on some leaves.

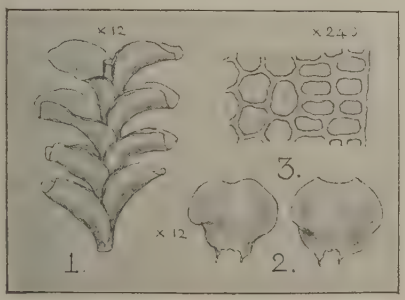
Our other members of the group, *M. Pearsonii* and *M. aquatica* are generally considered to be what are now termed "small species." They are very closely related to *M. emarginata* and cannot always be distinguished from it, but in most cases they can, and they are probably in the course of becoming distinct species.

M. emarginata has quadrate-rotund leaves in the typical plant, but they are frequently almost rotund, especially in alpine localities; the lobes are commonly obtusely pointed or obtuse, but not rotundate.

This species varies greatly in nearly all its characters. I had hitherto considered the small, dark plant, growing on soil by roadsides and footpaths, to be the var. *minor* Carr., but it is so variable in its characters, except the small size, that it cannot be classed as any particular variety, and specimens in my possession of the var. *minor* from Carrington's herbarium, include different forms and are subalpine rock plants which hardly differ from the type except in size. In the roadside plant referred to, the sinus is commonly acute and the lobes subacute or apiculate, the margin is also frequently only slightly reflexed. Occasionally one meets with quite small forms of *M. emarginata* on dry rocks, but as a rule they are only immature plants.

66. Marsupella Pearsonii Schiffn.

Marsupella Pearsonii Schiffn. in litt. Macv., Journ. Bot. p. 117 (1905); K. Müll., Krypt. Fl. p. 480 (1909); Schiffn., Krit. Bemerk. in Lotos p. 29 reprint (1910).



1. Part of stem. 2. Leaves. 3. Cells.

Dioicous. In extended *reddish* patches. Stems 3–5 cm long, firm, suberect, usually simple, repeatedly innovant from below the ♀ inflorescence, cortical layer of cells with thick walls of about the same size as the internal cells; rhizoids colourless or sometimes violet, almost confined to the stolons and base of stems. Leaves *shiny*, approximate, subimbricate above, semi-amplexicaul, of nearly the same size throughout, patent or horizontal from a recurved base, channelled, orbicular, $\frac{1}{10}$ bilobed, *sinus very shallow and broad or almost obsolete*, lobes *apiculate* or sometimes rounded, the antical margin

reflexed; cells 18–26 μ, much smaller towards the margin, rounded-oblong or 4–6-angled, *the walls greatly and almost equally thickened*, trigones generally none. Subinvolucral bracts broadly rotund with broad base, sinus frequently deeper and acute, lobes sometimes rotundate; involucral bracts erect, connate to the middle, sinus shallow, obtuse, lobes apiculate or obtuse. Perianth slightly shorter than the bracts and connate with stem for $\frac{1}{2}$–$\frac{3}{4}$, the free portion 4-lobed. Capsule reddish-brown, inner layer of wall with semi-annular thickenings. Spores 10–14 μ, reddish-brown, granular-punctate. Elaters 8–9 μ thick, reddish-brown, bispiral. ♂ bracts in 3–5 pairs, imbricate, strongly complicate, ventricose, otherwise resembling the leaves. Antheridia 3–5, oval, longly pedicellate.

HAB. On frequently submerged rocks in marshy ground in the subalpine region, seldom in the alpine and ascending to 2800 ft. alt.

DISTRIB. Wales and Yorkshire to Shetland, uncommon. Fr. April–July.

The most marked character of this plant lies in the shape of the apex of leaf. The sinus is very shallow, so much so as to be sometimes practically obsolete, and it is not obtusely pointed but is broadly lunate. At the junction of the sinus and the external margin of the leaf—it is hardly expanded sufficiently to be termed a lobe—there is very commonly an apiculus, which is sometimes, however, destroyed, and the apex is then rounded, but it does not form a broad rotundate lobe.

M. Pearsonii is very closely related to *M. aquatica*, and it is sometimes very difficult to separate them. The leaves in the former are shiny, the cells have more strongly thickened walls with a smaller lumen and the marginal cells are considerably smaller than the internal cells and are greatly incrassate; also the plant seems to be always reddish when well developed. The habitat is peculiar, the plant being almost always confined to nearly flat rocks over which there is a constant trickle of water, on the lower slopes of the hills, with the surrounding ground marshy, owing usually to some rill not having a constant channel.

This plant has not yet been described by Prof. Schiffner. The name originated through a specimen of *Anthelia julacea* in my herbarium gathered in Borrowdale by Mr. Pearson in 1893 and sent by me in 1902 to Schiffner. Among the *Anthelia* were some stems of a *Marsupella*, which had been taken for *M. emarginata*, but some of which Schiffner returned to me as a new species, viz., *M. Pearsonii*. This I published three years later in the *Journal of Botany* with some notes but without a description. A description was subsequently published by Müller in his *Krypt. Fl.*

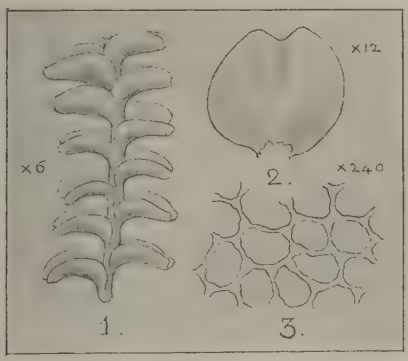
67. Marsupella aquatica (Lindenb.) Schiffn.

Jungermannia emarginata var. *aquatica* Lindenb., Syn. Hep. Eur. p. 75 (1829).

Jungermannia aquatica Schrad., Fl. Germ. p. 75 (1794).

Sarcoscyphus Ehrharti var. *robustus* De Not., Comm. Soc. Critt. Ital. 1 fasc. 2 p. 80 (1861).

Marsupella aquatica Schiffn., Lotos No. 3 p. 44 reprint (1901).
Marsupella robusta Evans, Rhodora p. 186 (1908).



1. Part of stem. 2. Leaf. 3. Cells.

Dioicous. In extended *dull green or blackish*, rarely reddish patches. Stems generally *tall*, 3–8 cm, or more, *robust*, erect, usually simple, frequently innovating from below the ♀ inflorescence, cortical layer of cells with thick walls of about the same size as the internal cells; rhizoids violet or colourless, almost confined to the stolons. Leaves approximate, semi-amplexicaul, of nearly the same size throughout, *horizontal from a recurved base*, *channelled*, *orbicular*, $\frac{1}{8}$ bilobed, sinus broad, rounded, *lobes rotundate*, the antical margin reflexed; cells 18–26 μ, or sometimes larger, smaller towards the margin, rounded-hexagonal, the *walls considerably thickened*, either equally so throughout or more strongly at the angles with the trigones conspicuous. Subinvolucral bracts with frequently an acute sinus, lobes rotundate; involucral bracts erect, connate to near the middle, sinus generally obtuse, the lobes sometimes obtusely pointed. Perianth $\frac{1}{3}$ shorter than the bracts and connate with them to the middle, the free portion 4–6 lobed. Capsule oblong-cylindrical, reddish-brown, inner layer of wall with semi-annular thickenings. Spores 9–12 μ, reddish-brown, granular-punctate. Elaters 140–200 μ, reddish-brown, laxly bispiral. ♂ bracts in 3–4 pairs, imbricate, shortly complicate, ventricose, sinus acute, lobes obtusely pointed. Antheridia 3–5, oval.

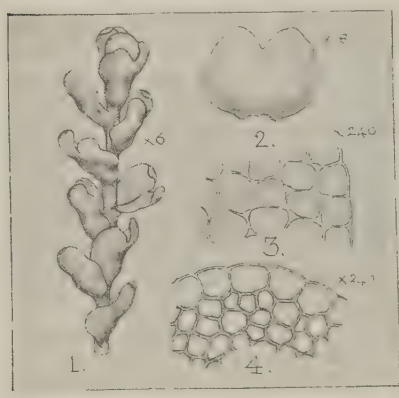
Hab. On wet, dripping rocks or submerged in streams and at the margin of lakes, in the subalpine and alpine regions.

Distrib. Wales and Yorkshire to Shetland, rather common; Ireland. Fr. April–July.

This species grows on rocks in water or at least where they are constantly wet. It differs from *M. emarginata* in being stouter, frequently elongated when submerged, leaves more rigid, channelled and more horizontal; they are also orbicular, the sinus is shallower, the lobes rotundate and the cells rather larger with the walls more strongly and more equally thickened. The more spreading leaves make them appear as if distant, and they have occasionally three lobes. The colour is commonly dull green and is frequently almost black, while *M. emarginata* is generally brown or reddish-brown.

68. Marsupella sphacelata (Gies.) Lindb.

Jungermannia sphacelata Gies. in Lindenb., Syn. Hep. Eur. p. 56 (1829).
Marsupella sphacelata Lindb., Meddel. Soc. F. Fl. Fenn. 13 p. 238 (1886); Schiffn., Lotos No. 3 p. 53 reprint (1901); K. Müll., Krypt. Fl. p. 484 (1909).



1. Part of stem. 2. Leaf. 3. Cells. 4. Transverse section of stem.

Dioicous. *In swelling tufts, dull green* and *generally tinged with brown above.* Stems 2·5–4 cm long, thick and *flaccid*, pale coloured, simple or occasionally with a few branches, fasciculately innovant from below the ♀ inflorescence, cortical cells hyaline, *thin-walled, twice as large* as the internal cells; rhizoids colourless or violet, scarce on stolons as well as stems. Leaves *flaccid*, mostly destroyed below, distant when present, subimbricate above, gradually increasing in size upward, erecto-patent, *embracing and crossing the stem*, *rotund-cordate to rotund-quadrate*, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, sinus acute and open, lobes rounded, *margin plane;* leaves on stems without inflorescence and on innovations hardly increasing in size upward, oblong-quadrate, subimbricate; cells 21–28 μ, 5–6-angled, the marginal row quadrate, *walls thin*, and usually pale coloured, *trigones small* but distinct. Involucral bracts very broad, convolute, the margin frequently plicate in the middle, $\frac{1}{3}$ bilobed, lobes rounded.

Hab. Submerged in alpine streams.

Distrib. Cairngorm Mts., very rare; Ireland?

Although *M. sphacelata*, *M. Sullivantii* and *M. Jörgensenii* are here described separately, they can only doubtfully be considered as species distinct from one another, though probably they are in the process of becoming so. Schiffner in No. 348 of his *Hep. Eur. Exs.* has presented both *M. sphacelata* and *M. Sullivantii* from the same station, the former being the aquatic condition of the plant and the latter the subterrestial form, with in addition intermediate forms. This close relationship, however, is not always to be seen. *M. sphacelata* is much rarer than *M. Sullivantii* and is much more distinctly alpine; its distribution in latitude is also more restricted both in Europe and N. America. Schiffner mentions in his *Krit. Bemerk.* to No. 348 that the two plants appear to be more strongly separated in the Riesengeberg mountains than in Norway, and Evans in speaking of the relationship of *M. Sullivantii* to *M. sphacelata* and of *M. aquatica* to *M. emarginata*, in *Rhodora* 1904 p. 168, says "Even if

they [the distinguishing characters] are not yet wholly permanent, they are assuredly species in the process of evolution." In Britain *M. sphacelata* is very rare and has only been found on the Cairngorm Mountains.

M. Jörgensenii is in a rather different position, as direct intermediates between it and *M. Sullivantii*, to which it is most closely related, together with typical forms of both, have not been found in the same station. Forms which approach each other do occur and it is sometimes difficult to place them. *M. Jörgensenii* prefers lower altitudes than is usual with *M. Sullivantii* in Scotland, and not rarely also rather drier habitats.

M. sphacelata is an aquatic plant and forms spongy masses. It is more flaccid than the others and is different in colour, the greater part of the plant being dull green while the upper part has usually a scorched appearance. The leaves embrace and cross the stem, and are not narrowed at the base as in *M. Sullivantii*. The walls of the leaf-cells are thin, with small trigones.

69. Marsupella Sullivantii (De Not.) Evans

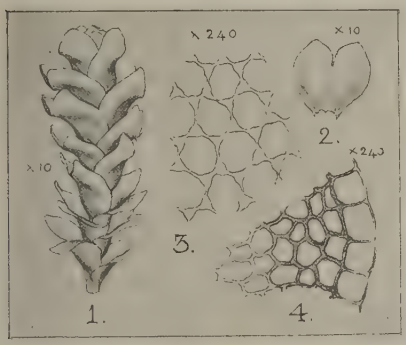
Sarcoscyphus sphacelatus var. *medius* Gottsche in Gott. and Rabh., Hep. Eur. Exs. No. 137 (1860).

Sarcoscyphus Sullivantii De Not., Comm. Soc. Critt. Ital. 1 p. 84 (1861).

Sarcoscyphus sphacelatus b. erythrorhizus Limpr., Krypt. Fl. Schles. 1 p. 432 (1876).

Marsupella erythrorhiza Schiffn., Lotos No. 3 p. 48 reprint (1901).

Marsupella Sullivantii Evans, Rhodora p. 57 (1907).



1. Stem. 2. Leaf. 3. Cells. 4. Section of stem.

Dioicous. In loose or slightly compact tufts, dark reddish-brown to *purple black* in colour. Stems 1–3 cm long, *firm*, with rather numerous stolons, simple or with few branches, sometimes with innovations from below the ♀ inflorescence; cortical layer of cells hyaline *with thin walls* much *larger than the internal cells*; rhizoids numerous on the stolons and lower part of stems, scarce in the upper part, *violet coloured* but frequently bleached. Leaves somewhat shiny, patent to erecto-patent, frequently squarrose on the sterile stems, *obcordate*, narrow at base, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, sinus *narrow*, *acute*, lobes usually *rounded at apex* and incurved, occasionally subacute on the sterile stems, *margin plane*; cells 21–25 μ, 5–6-angled, *the marginal row nearly rectangular*, walls reddish-brown, slightly thickened, *trigones large*. Involucral bracts erect, large, $\frac{1}{3}$ to nearly $\frac{1}{2}$ connate, rotundate, $\frac{1}{3}$ bilobed,

sinus very acute, lobes rounded at apex. Perianth slightly shorter than the bracts and $\frac{1}{3}$–$\frac{1}{2}$ connate with them. Capsule yellow-brown. Spores 7 μ, yellow-brown, smooth. ♂ bracts imbricate, oblong-quadrate, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, sinus acute, lobes obtuse. Antheridia 2–3, oval, on a pedicel of nearly equal length.

HAB. On wet peat or stony, marshy places in the subalpine and alpine regions, ascending to 3600 ft. alt.

DISTRIB. Wales to Shetland, rare; Ireland.

Is of a firmer consistency and darker colour than *M. sphacelata* and is less aquatic; the leaves are more deeply divided and the lobes are occasionally sub-acute; the walls of the leaf-cells are more thickened and are reddish-brown, and the trigones are larger.

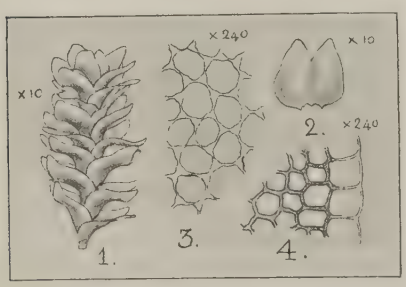
The rhizoids are frequently bleached so as to be almost colourless. Some stems may be found creeping throughout nearly their whole length, and, in this case, bear numerous, usually brightly tinged rhizoids. Violet rhizoids are not confined to this group and are sometimes present in other members of this genus.

This group can be easily known from the *M. emarginata* group by the different shape of leaf, deeper sinus and plain antical margin. The structure of the stem is also different. A cross-section in the *M. sphacelata* group shows a cortical layer of large, thin-walled cells and within this the cells have more or less thickened walls which gradually become thin again in the internal cells. In the *M. emarginata* group, although the cortical cells may be somewhat larger than the internal cells, they have thick walls.

M. Sullivantii has been confused by beginners with *Gymomitrium alpinum*, but this should be easily avoided. The *Gymnomitrium* has quite a different habitat, i.e., rather dry and exposed rocks, and it is smaller with a different shape of leaf and smaller leaf-cells.

70. Marsupella Jörgensenii Schiffn.

Marsupella Jörgensenii Schiffn., Krit. Bemerk. Eur. Leb. in Lotos No. 3 p. 51 reprint (1901); K. Müll., Krypt. Fl. p. 487 (1909).



1. Stem. 2. Leaf. 3. Cells. 4. Section of stem.

Dioicous. Resembling *M. Sullivantii* in size, colour, habit and structure of stem. Leaves of fertile stems erecto-patent, oblong-ovate on the lower part of stem, *cordate*-ovate to rotund-quadrate above, $\frac{1}{3}$ bilobed, sinus narrow, acute, lobes rounded or occasionally only obtuse; leaves of sterile stems patent to *squarrose*, *cordate* at base, $\frac{1}{3}$ bilobed, lobes obtuse to sub-acute, less frequently rounded

at apex; cells *17–21* μ, otherwise as in *M. Sullivantii*. Involucral bracts erect, much larger than the leaves, $\frac{1}{3}$ to nearly half connate, oblong-ovate to oblong-cordate, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, sinus narrow, acute, lobes rounded at apex. Perianth $\frac{1}{3}$ shorter than the bracts, connate with them to nearly the middle. Capsule oval-globose, reddish-brown, inner layer of wall without semi-annular thickenings. Spores 8–9 μ, light brown, very finely granulate. Elaters bispiral, reddish-brown, 210–250 μ long and 8–9 μ broad, strongly contorted and slightly attenuate. ♂ bracts in several pairs, broadly ovate to cordate at base, $\frac{1}{4}$ bilobed, sinus acute, lobes usually acute, the antical margin frequently partly reflexed. Antheridia 2–3, large, oval, on a pedicel of nearly equal length.

HAB. On wet, stony, peaty ground in the subalpine region.

DISTRIB. Kirkcudbright to Inverness, rare; Ireland.

Can generally but not always be distinguished from *M. Sullivantii*. The leaves vary considerably in shape, but they are as a rule broadest below the middle instead of above it as in the other, and are broadly cordate at base; the cells are also smaller. The leaves are also sometimes more squarrose, the lobes more pointed and the oil-bodies in the leaf-cells more conspicuous.

XXII. ALICULARIA Corda

Alicularia Corda in Opiz, Beitr. 1 p. 652 (1829).
Nardius S. F. Gray, Nat. Arr. Brit. Pl. 1 p. 694 (1821).
Mesophylla Dum., Comm. Bot. p. 112 (1822).

Plants small to medium sized, caespitose. Stems prostrate to suberect, little branched, branches proceeding from the postical angle of the leaves; rhizoids usually numerous, long, pale. Leaves alternate, obliquely inserted and succubous, frequently vertical-connivent near the perianth, *roundish, entire*, seldom emarginate. *Underleaves present on the stem, lanceolate.* ♀ bracts composed of 2–3 pairs of nearly opposite leaves resembling the stem leaves. Perianth tender, *included and concrete with the involucral bracts and the hollowed out apex of the stem* to form an urceolate involucre which is sometimes bulbous-thickened and rooted at the base, the apex contracted, conical, the mouth crenulate. Calyptra free. Capsule oval-globose,

the wall of two layers of cells, the inner with numerous semi-annular thickenings. Spores small; elaters generally bispiral. Androecia terminal or at the middle of the stem in dioicous species, bracts saccate, otherwise resembling the leaves; antheridia 1–3.

In *A. Geoscyphus* and *Breidleri* the apex of the fertile stem becomes swollen and forms a fleshy sac (perigynium) inside of which at the bottom the foot of the sporogonium penetrates. This sac forms a solid, bulbous enlargement at the base and roots in the ground, while above this it grows erect and has the bracts on its outer surface and the rudimentary perianth at its mouth.

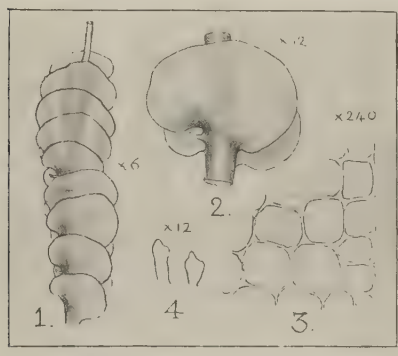
1 { Plant very minute, 2–3 mm high, reddish-brown; alpine.....74. *Breidleri*
  { Plant larger.....2

2 { Paroicous; involucre usually saccate and nearly at right angles to stem 73. *Geoscyphus*
  { Dioicous; involucre not as above.....3

3 { In large spongy masses, usually purple; stems with few rhizoids; cortical cells larger than the internal cells; leaves reniform; aquatic.....71. *compressa*
  { In green or reddish patches on soil, rarely in water; stems usually with many rhizoids, cortical cells smaller than the internal cells; leaves orbicular 72. *scalaris*

71. Alicularia compressa (Hook.) Nees

Jungermannia compressa Hook., Brit. Jung. *pl.* 58 (1813).
Nardius compressus Gray, Nat. Arr. Brit. Pl. 1 p. 694 (1821).
Mesophylla compressa Dum., Comm. Bot. p. 112 (1822).
Alicularia compressa Nees, G. L. N. Syn. Hep. p. 12 (1844).



1. Fertile plant. 2. Leaves on stem. 3. Cells. 4. Underleaves.

Dioicous. In large, *submerged, swelling tufts*, dark *purple* in colour, or dull green, and usually tinged with purple. Stems 2–12 cm long, slender, *not brittle, erect or suberect*, simple or with few branches, innovant; *cortical cells larger than the small internal cells*; flagella sometimes present; rhizoids whitish, scarce below, *almost absent upwards*. Leaves thin, *transparent, erecto-appressed* and imbricate, almost plane, extending broadly and *almost equally* beyond the stem on both

sides, *reniform* or seldom orbicular, slightly decurrent. Cells 28–36 μ, rounded hexagonal, *smaller* and subquadrate at the margin, walls somewhat thickened, trigones small or rather large, distinct or indistinct, smaller at the base where the cells are elongate, oil-bodies sometimes distinct. Underleaves small, suberect, triangular or ligulate, occasionally bilobed at apex, *scarce* except on the innovation and apex of stem. Involucral bracts broader than the leaves, *flat*, *compressed*; bracteole ovate, irregularly lobed. Perianth immersed, obconical, the free apex violet, longly crenulate at the contracted mouth. Capsule broadly oval, reddish-brown, on a pedicel to 10 mm long; semi-annular thickenings of inner wall reddish-brown. Spores 14–16 μ, nearly spherical, *reddish-violet*, granulate. Elaters of same colour, bispiral. ♂ bracts in 3–4 pairs; antheridia 2–3; oval-globose, on a pedicel of about half their length.

var. **rigida** Lindb., Hep. in Hib. lect. p. 531 (1875).

Rigid, brown to purplish-brown, narrower and more slender than the type, densely leaved, the leaves rigid, usually less compressed; cells rather larger and with larger trigones, marginal row of cells always distinct.

var. **gigantea** Macv. n. var.

Tall and robust, 18–22 cm long and 2·5–2·8 mm broad, yellowish-brown with the apex dull green. Leaves imbricate, erect with the apex patent, the antical margin *longly decurrent*; cell-walls thinner than in the type, the trigones small, cells *at and near* margin *subquadrate and distinctly smaller* than the internal cells.

Hab. On wet or submerged rocks in the subalpine and lower alpine regions ascending to 2800 ft. alt.

Distrib. Dartmoor and Wales to Shetland, uncommon; Ireland. Fr. April–May. Var. *rigida*, Scotland, Ireland. Var. *gigantea*, in stream on Bow Fell, alt. 1550 ft., 1908 *(J. A. Wheldon)*.

The large, swollen, reddish-purple to dark purple tufts of the typical plant do not resemble those of other species of this genus or of *Eucalyx*; they are more like the tufts of *Aplozia cordifolia* or *Scapania uliginosa*. The leaves are semi-pellucid, the stems being seen through them. As with most other aquatic plants, the stems are denuded of leaves at the base. The involucral bracts are compressed and flat at the apex or slightly undulate, and thus lie against one another.

This species varies greatly in appearance. Some plants have densely leaved stems and these include green or highly coloured forms, with leaves appressed or more or less patent; more rarely are the stems laxly leaved with the leaves widely spreading or even squarrose, and appearing as if distant. The size of the

leaves also varies considerably and to a less extent the size of the cells. The leaves are almost always broader than long, but in some of the closely imbricated and dark coloured smaller plants, they are sometimes nearly orbicular.

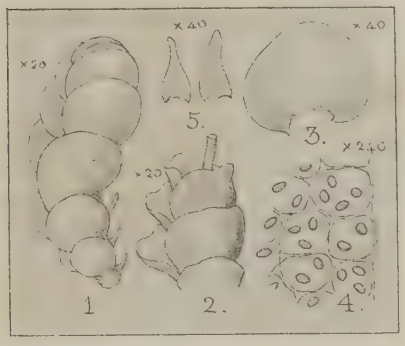
A. compressa differs from aquatic forms of *A. scalaris* in the structure of the stem, leaves almost always broader than long and extending considerably beyond the postical side of the stem, more decurrent, cells distinctly smaller towards the margin, and generally in the colour of the plant; even in the green forms with widely spreading leaves, some stems can almost invariably be found with a few erecto-appressed, imbricate and nearly flat leaves characteristic of the species, and having a leaf here and there partly or wholly with a purple tinge.

Underleaves are usually present towards the apex of the stem and will assist in preventing confusion with any species of *Eucalyx* or *Aplozia*.

The var. *rigida* is rather less aquatic than the type; the leaf-cells vary in size but are generally only slightly larger than in the typical plant, and are sometimes, I believe, of the same size. The var. *gigantea* is very large and distinct looking.

72. Alicularia scalaris (Schrad.) Corda

Jungermannia scalaris Schrad., Syst. Samml. Krypt. Gew. 2 p. 4 (1797).
Nardius scalaris Gray, Nat. Arr. Brit. Pl. 1 p. 794 (1821).
Alicularia scalaris Corda in Opiz, Beitr. 1 p. 652 (1829).



1. Sterile stem. 2. Fertile stem. 3. Leaf. 4. Cells. 5. Underleaves.

Dioicous. In deep green or reddish-brown patches. Stems 1–3 cm long, thick, *brittle*, *prostrate* with ascending apex, simple or with few branches, cortical cells smaller than the large internal cells; *rhizoids numerous*, long, white. Leaves not transparent, erecto-patent or patent, slightly obliquely inserted, concave, orbicular, very slightly decurrent; cells 25–36 μ, hardly smaller towards the margin, rounded-hexagonal, walls slightly thickened, trigones large, distinct; *oil-bodies 2–4 in each cell*, *large*, *oval*, *smooth and glistening*, *long persistent*. Underleaves *numerous*, triangular-subulate, patent. Involucral bracts larger than the leaves, frequently emarginate, concave, not undulate; bracteole lanceolate, entire or subdentate. Perianth immersed, narrowly pyriform, the free apex crenulate-dentate. Capsule broadly oval, brown; semi-annular thickenings of inner wall brown. Spores 15–17 μ, *brown*, granular-papillate. Elaters pale reddish-brown.

♂ bracts in few pairs, imbricate, more concave than the leaves; antheridia 2–3, globose, on a pedicel of almost equal length.

var. **procerior** Schiffn., Krit. Bemerk. u. die eur. Leb. II Serie in Lotos nr 8 p. 25 reprint (1901).

In erect tufts on moist or wet ground, deep green with the apex occasionally reddish-brown. Stems 1·5–3 cm long, *erect or ascending*; leaves mostly *patent*, rather more distant and less concave than in the type.

var. **distans** Carr., Brit. Hep. p. 24 (1874).

In rather large, *erect*, *swollen*, *pale green tufts in water*. Stems 3–8 cm long, succulent, the internal cells rather smaller than in the typical plant, rhizoids scarce. Leaves *distant*, usually small, *erecto-patent*, *concave* and somewhat ventricose, *shrinking when dry;* cell-walls thin, trigones minute, oil-bodies mostly indistinct.

var. **rivularis** Lindb., Hep. in Hib. lect. p. 531 (1875).

In dense, submerged tufts. Plant to 7 cm long and 2 mm broad, pale-reddish, erect, with stems slightly or not branched; leaves less patent than in the type.

HAB. Banks, roadsides, rocks, etc., ascending to 4400 ft. alt.

DISTRIB. N. to Shetland, common except in calcareous districts; Ireland. Fr. Mar.–June. Var. *rivularis*, in stream above Lough Bray, Co. Wicklow, 1873 *(S. O. Lindberg)*.

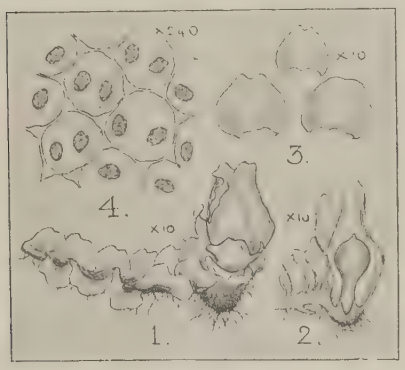
Sterile plants can be known in most cases from all other entire, round-leaved species by the numerous subulate underleaves, which being patent, are easily seen, and by the large, smooth and shining oil-bodies in the leaf-cells. A mistake should only be possible in aquatic forms; these have fewer rhizoids and underleaves, the oil-bodies not so persistent and the trigones smaller, but, in this case, it is seldom that some cells cannot be found with the glistening oil-bodies. In the prostrate forms of wet ground a few underleaves can always be found near the apex of some of the stems; if they are overlooked, the plant might be mistaken for *Aplozia crenulata*, which, however, has usually equally thickened cell-walls even if the characteristic large marginal cells be absent.

The var. *procerior* is larger than the type and forms erect or suberect tufts in wet ground. It may perhaps grade off into the common form of the plant in the same station, but I have not seen this. Var. *distans* is an aquatic plant and is taller but with rather small leaves; it is noticeable for the shrinking of the leaves when dry; it is a more distinct variety than the previous. Var. *rivularis*, which I have not seen, appears to be the largest and most robust form of the species.

Fruit is more common in *A. scalaris* than is usually the case with dioicous species.

73. Alicularia Geoscyphus De Not.

Jungermannia scalaris β minor Nees, Eur. Leb. I p. 281 (1833).
Jungermannia haematosticta Nees, Eur. Leb. II p. 453 (1836) [nomen nudum].
Alicularia Geoscyphus De Not., Mem. Acad. Tor. II 18 p. 486 (1859).
Alicularia minor Limpr., Krypt. Fl. Schles. p. 251 (1876).
Nardia minor Arnell, Leb. Stud. Nördl. Norw. p. 39 (1892).



1. Fertile stem. 2. Section of do. 3. Leaves. 4. Cells.

Paroicous. In rather small, reddish-brown to purple, seldom altogether green patches. Stems *short* to 1 cm long, prostrate with ascending apex, flexuose, simple or with few branches, *frequently violet beneath*; rhizoids numerous, long, white or sometimes violet. Lower leaves distant, frequently retuse, upper leaves, of the fertile stems especially, imbricate, concave, erecto-patent or patent, slightly obliquely inserted, orbicular, *generally emarginate*, rarely bilobed; cells to 36 μ, rounded-hexagonal, hardly smaller towards the margin, walls slightly thickened, trigones sometimes rather large, distinct; *oil-bodies seldom distinct, dull, roughened, not persistent.* Underleaves broadly lanceolate, *scarce* and almost *confined to the upper part of the fertile stems.* Involucre in the typical plant almost at *right angles* to stem, *bulbous and rooting at the base.* Involucral bracts broader than the leaves, emarginate, *undulate-lobate* or *crispate-sinuate*; bracteole large, irregularly 2–3-lobed. Perianth slightly shorter than the bracts, the free apex crenulate. Capsule broadly oval. Spores 14–16 μ, reddish-brown, finely granular-papillate. Antheridia below the ♀ inflorescence in the axils of emarginate and sinuate bracts.

var. **suberecta** Lindb., Musc., Scand. p. 8 (1879).

Jungermannia silvrettae Gottsche in G. & R., Hep. Eur. Exs. nr 470 (1869).
Nardia repanda Lindb. in Carr., Brit. Hep. p. 27 (1874).

Taller, green; stems to 2·5 cm long, suberect or ascending, leaves more distant, more or less undulate, cells rather larger with

thin walls and small trigones; fertile stems erect, fleshy towards the apex but not bulbous at the involucre.

HAB. On old walls, banks and moors ascending to 2500 ft. alt. at least.

DISTRIB. N. to Ross, rather rare. Fr. March–June.

Sterile plants may be separated from *A. scalaris* by the almost complete absence of underleaves except at the apex of the stem and by the oil-bodies in the leaf-cells being seldom distinct, never shining nor smooth; the last character is the most important. *A. scalaris* has occasionally a few leaves which are emarginate and the involucral bracts are frequently so, but the other has some leaves on the fertile plant almost always emarginate, though they are mostly entire on the sterile stems. The occasional violet rhizoids may cause the plant to be mistaken for *Eucalyx hyalinus*; the latter has, rarely, retuse leaves, but not with the small emargination of *A. Geoscyphus*, and underleaves are absent.

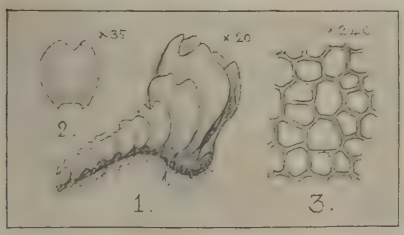
Fertile plants of the type are readily known by the bulbous, rooting involucre; the var. *suberecta* has the apex of the stem fleshy but not bulbous. The crispate or undulate bracts are usually noticeable, and if the paroicous inflorescence be distinguished, there should be no doubt of the identity of the species. Antheridia should be looked for before the involucre is developed. A paroicous inflorescence with crispate bracts occurs in *Lophozia excisa*, which is somewhat of a similar appearance and frequently in the same kind of habitat, but on closer examination the two species are very different.

The var. *suberecta* is the form of shady or moist ground. It cannot always be distinguished from the typical plant.

Var. *insecta* (Lindb.) has the leaves of both fertile and sterile stems usually $\frac{1}{4}$–$\frac{1}{3}$ bilobed, the sinus acute or subacute and the lobes acute or subacute, rarely rotundate; the leaves on some stems are occasionally entire, especially towards the apex of the fertile branches. I have not seen this variety in Britain. It is widely distributed on the Continent.

74. Alicularia Breidleri Limpr.

Alicularia Breidleri Limpr., Jahresb. Schles. Ges. Vaterl. Cult. 57 p. 311 (1880).
Nardia Breidleri Lindb., Soc. F. Fl. Fenn. (1880).



1. Fertile stem. 2. Leaf. 3. Cells.

Dioicous. *Very minute.* In dense *reddish* to purple-brown depressed patches. Stems 2–3 mm long, sinuous or arcuate, simple or with few branches, frequently with some small-leaved ventral shoots; rhizoids long, white, to near apex of stem. Leaves generally distant or approximate, about twice the breadth of the stem, concave,

erecto-patent, rotund to broadly-oblong, $\frac{1}{5}$–$\frac{1}{4}$ *bilobed* with an obtuse or rounded sinus and *broad, obtuse, somewhat connivent lobes, or only emarginate* with a broad and shallow sinus, the upper leaves sometimes *retuse* or rounded at the apex on sterile stems; cells 16–21 μ, 5–6-angled, the marginal row subquadrate, *walls usually reddish, equally thickened*, trigones thus absent, *oil-bodies absent*, cuticle smooth. Underleaves soon destroyed below, *small, subulate* and erecto-patent above. ♀ inflorescence terminal or on a short, small-leaved, clavate branch; *involucre thick and fleshy*, usually *bulbous and rooting below*; involucral bracts larger than the leaves and broader than long, the sinus usually rounded, bracteole oblong-ovate. Perianth immersed, the free part conical and crenulate at the mouth. Capsule nearly globose, the semi-annular thickenings of the inner layer of the wall pale brown or nearly transparent. Spores 9–11 μ, reddish-brown, rounded-tetrahedral, granulate. Elaters 63–84 μ, slightly attenuated, mostly trispiral, the spiral fibres very narrow, reddish-brown. ♂ plant more densely leafy, bracts broad, the antical margin frequently with a tooth; antheridia 1–2, large, globose.

HAB. On bare moist soil near the summits of the higher hills, 3200–4000 ft. alt.

DISTRIB. Perth, Forfar, Inverness, rare.

This is one of our smallest hepatics, but as it grows in patches of a few inches or more in diameter and of a reddish colour, it is not difficult to distinguish in the field. Sterile plants might be mistaken for a *Cephalozia*, but it does not bear much resemblance to any of our species of that genus. The presence of underleaves and the absence of oil-bodies in the leaf-cells will distinguish sterile plants from small species of *Gymnomitrium* or *Marsupella*. The frequently only emarginate leaves near the apex of the stems are unlike those of any other of our species except perhaps *A. Geoscyphus*; the latter is a larger plant with many of the leaves entire and with the cell-walls generally colourless. The reddish cell-walls of the present plant are frequently the means of detecting this minute species among other plants. It is very frequently found in company with *Anthelia Juratzkana*, to which it has no resemblance.

Near the apex of sterile stems, the leaves are sometimes narrowly oblong or almost cuneate and with the apex rounded or retuse. Chlorophyll granules occur only in small quantity in the leaf cells.

Schiffner gives in his *Hep. Eur. Exs.* nr 356 a var. *suberecta*, analogous to the same variety of *A. Geoscyphus*.

XXIII. EUCALYX Breidl.

Nardia Lindb., Act. Soc. Sc. Fenn. 10 p. 115 (1871).
Nardia Sect. 1 *Eucalyx* Lindb., Bot. Notis. p. 167 (1872).
Southbya Husnot, Hep. Gall. p. 15 (1875).
Eucalyx Breidl., Mitt. Nat. Ver. Steierm. p. 291 (1893).
Mesophylla Corbière, Revue Bryol. p. 13 (1904).

Plants medium sized, rarely small, with the habit of *Aplozia*. Stems ascending to erect, little branched, the branches proceeding from the postical angle of the leaves, frequently *with violet coloured rhizoids*. Leaves alternate, obliquely inserted and succubous, laxly imbricate, *roundish to oval, entire. Underleaves absent.* ♀ involucral bracts generally composed of two nearly opposite leaves resembling the stem leaves. Perianth ovate, exserted, *concrete in its lower half, or nearly so, with the involucral bracts.* Capsule oval-globose, the wall of two layers of cells, the inner with numerous semi-annular thickenings. Elaters bispiral. ♂ bracts beneath the perianth or at the apex of branches on separate plants, saccate; antheridia 2–3.

This is an artificial genus but is useful for practical purposes. It is founded chiefly on the involucral bracts being adnate to the lower half, or usually less, of the perianth, and the latter not being included in the bracts as in *Alicularia*. It can also be known from that genus by the absence of underleaves on the stem. The two genera have generally been united in the single genus *Nardia* in this country. On the other hand, *Eucalyx* is closely connected with *Aplozia*. The latter has the perianth free from the bracts, but sometimes not entirely so, especially in the case of *A. crenulata*, in which the bracts are occasionally adnate to a little above the base of the perianth; in fact, that species has sometimes been placed in the one genus and sometimes in the other. In addition to the perianth being usually free in *Aplozia*, it is generally longly exserted; underleaves are absent.

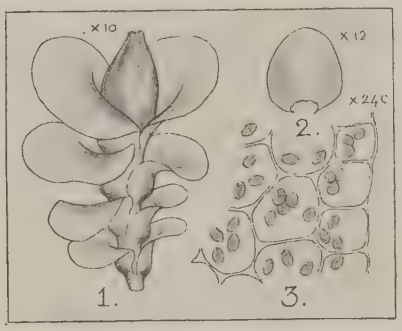
1 { Bracts adherent for $\frac{1}{2}$–$\frac{3}{4}$ of the perianth; paroicous; trigones small.....2
  Bracts adherent for less than $\frac{1}{2}$ of the perianth; paroicous or dioicous; trigones rather large 3

2 { Stems 2–3 cm long or more, leaves ovate to subrotund, cuticle usually distinctly striate-verruculose.....75. *obovatus*
  Stems to 1 cm long, leaves oval or elliptical, cuticle usually smooth or faintly punctate-verruculose .....76. *subellipticus*

3 { Dioicous; leaf-cells 28–36 μ, seldom to 42 μ .....78. *hyalinus*
  Paroicous; leaf-cells 42–56 μ, trigones large.....77. *paroicus*

75. Eucalyx obovatus (Nees) Breidl.

Jungermannia obovata Nees, Eur. Leb. I p. 332 (1833).
Southbya obovata Lindb., Hartm. Skand. Fl. ed. 10 2 p. 130 (1871).
Nardia obovata Carr., Brit. Hep. p. 32 (1874).
Eucalyx obovatus Breidl., Mitt. Nat. Ver. Steierm. p. 291 (1893).



1. Fertile stem. 2. Leaf. 3. Cells.

Paroicous. In *dark green to reddish-brown tufts* on wet rocks, frequently almost black when dry. Stems to 30 mm long, erect or suberect, flexuous, usually simple, innovating from beneath the inflorescence, with flagella below; rhizoids rather numerous, fasciculate, long, *purple*. Leaves distant below, oblique; imbricate and increasing in size upwards on the fertile stems and *nearly transverse*, patent to squarrose, *hollowed at base*, ovate to sub-rotund with the base usually *narrow*, antically decurrent; cells 25–33 μ, smaller towards the margin, rounded-hexagonal, the marginal row subquadrate, walls thin, trigones small, distinct, generally reddish-brown, *cuticle usually striate-verruculose*. Subinvolucral bracts 3–4 pairs or more, vaginate, saccate at base, erecto-patent with the upper third squarrose; antheridia commonly 2, oval-globose, pedicel short; involucral bracts larger, the upper part *patent to squarrose*, adnate to the *lower half* of the perianth. Perianth of *nearly similar length* to the involucral bracts, visible to $\frac{1}{3}$ through the recurvation of their upper part, the free portion *narrowly* conical, 4–6-plicate, *the mouth 2–3-lobed*. Capsule oval-globose, dark brown. Spores 17–21 μ, yellowish-brown, granular-papillate. Elaters reddish-brown.

var. **rivularis** Schiffn., Lotos 1 p. 6 reprint (1905).

In rather large, *submerged, erect and swollen, green tufts*. *Stems to 8 cm long*, frequently with several branches and with rather numerous flagella, rhizoids usually scarce, violet. Leaves larger than in the type and spreading; cells rather larger, the walls thin, trigones minute or absent.

Hab. On wet rocks in the subalpine and alpine regions ascending to 3200 ft. alt.

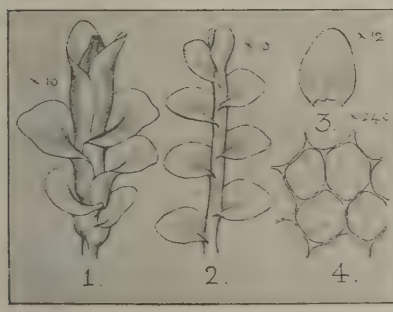
DISTRIB. Wales and Yorkshire to Shetland, frequent; Ireland. Fr. April–Aug. Var. *rivularis*, in rills, Ben Cruachan, Argyll.

Differs from *E. hyalinus* in its inflorescence, darker colour, bracts attached to the perianth for half its length on both sides, leaves concave at base with a narrower attachment, and reflexed, cells rather smaller and with smaller trigones, the cuticle most commonly distinctly striate-verruculose, the innovations more erect and slender. These innovations have a considerable resemblance to some sterile forms of *Aplozia riparia*, but that species has colourless rhizoids and much smaller trigones. The leaves of *E. obovatus* appear to be obovate when on the stem, but they are seen not to be so when dissected off. Rhizoids of aquatic forms are as a rule only slightly tinged with violet, many of them being colourless.

The var. *rivularis* is a submerged plant in mountain streamlets. In addition to this variety, we have f. *elongatus* Nees, *Eur. Leb.* III p. 538 which is found on dripping or frequently overflowed rocks; it has longer stems than the typical plant and is, in general, larger; and f. *laxus* Schiffn., *Krit. Bemerk. u. eur. Leb.* VIII Serie in Lotos p. 12 (1910) occurring in springs and wet ground, with the stems sometimes considerably lengthened and the leaves distant and flaccid. The small form of this species which I had hitherto considered to be the var. *minor* Carr. is omitted, as it is doubtful what plant is intended by Carrington without an examination of an authentic specimen. Judging from the localities which he gives in *Brit. Hep.* p. 33, the plant belongs to *E. obovatus* and not to *E. subellipticus* as has been suggested.

76. Eucalyx subellipticus (Lindb.) Breidl.

Nardia subelliptica Lindb., Meddel. Soc. F. Fl. Fenn. 4 p. 182 (1883).
Eucalyx subellipticus Breidl., Mitt. Nat. Ver. Steierm. p. 291 (1893).
Southbya subelliptica Lett, List Spec. Hep. Brit. Isles p. 140 (1902).



1. Fertile stem. 2. Sterile stem. 3. Leaf. 4. Cells.

Paroicous and sometimes heteroicous. *Minute.* In *yellow-green*, less commonly brownish, tufts, or among mosses. Stems to 10 mm long, rather thick, *ascending* to suberect, flexuous or arcuate, branched; rhizoids numerous, *brownish or hyaline*, sometimes pale red. Leaves distant and patent below, and oblique; subimbricate, *erecto-patent* and nearly transverse above, somewhat secund antically, broadly *oval*, concave. margin incurved; cells 23–30 μ, rounded-hexagonal, subquadrate at the margin, walls thin, *trigones small and frequently indistinct, cuticle smooth* or fine punctate-verruculose. Subinvolucral bracts rather larger than the leaves, erecto-patent, broadly oval to rotund-ovate,

saccate at base ; antheridia commonly 2, oval-globose, pedicel short; involucral bracts large, broadly oval, undulate, *erect* or squarrose at the apex, adnate to the lower $\frac{1}{2}$–$\frac{3}{4}$ of the perianth. Perianth of nearly similar length to the involucral bracts and generally hidden by them, the free portion *broadly conical* to ovate, plicate, the mouth crenulate, *not lobate*. Capsule *globose*.

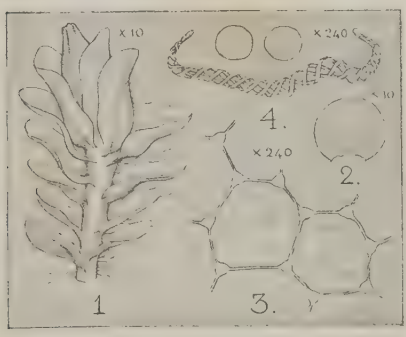
HAB. On moist soil and rock ledges.

DISTRIB. Ben Lawers district, 1800–3000 ft. alt., rare.

This small species resembles *Aplozia pumila* in appearance. It differs from *E. obovatus*, to which it is closely related, in its smaller size, yellowish-green colour, rhizoids most frequently colourless, leaves oval, less decurrent, cell walls less thickened at the angles, cuticle smooth or faintly punctate-verruculose, the commonly erect involucral bracts, the shape of the perianth and not lobed mouth and the more spherical capsule. The difference in the cuticle of leaf is noticeable, as, although sometimes almost striate, it is not markedly so as in *E. obovatus*, and it is frequently smooth, which is never the case with the other.

77. Eucalyx paroicus (Schiffn.) Macv.

Nardia paroica Schiffn., Krit. Bemerk. u. die eur. Leb. VIII Serie in Lotos p. 14 (1910).



1. Fertile stem. 2. Leaf. 3. Cells. 4. Elater and spores.

Paroicous. In yellowish-green to brownish-green patches, frequently tinged with violet red, resembling in size and appearance *E. hyalinus* or less frequently *E. obovatus*. Leaves rotundate, usually with a broad base ; cells large, *42–56* μ, with *large trigones*; *cuticle most commonly smooth. Involucral bracts and perianth as in E. hyalinus.* Spores *21–23* μ, elaters 12 μ thick.

HAB. On moist soil and rocks in the subalpine region.

DISTRIB. Wales to West Inverness, rare. Fr. April–May.

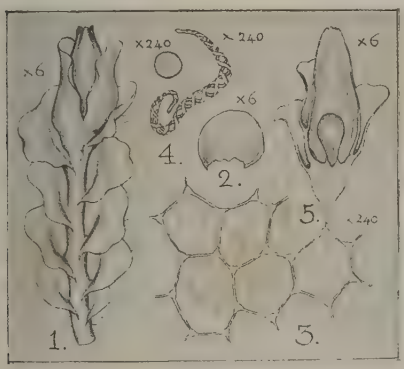
This is the plant which has hitherto been considered as the paroicous state of *E. hyalinus*. Schiffner has recently given it specific rank, as the paroicous inflorescence appears to be constant, and with it other differences, especially the

larger size of the leaf-cells. This appears to be the case in the few specimens from widely separated localities which I have seen, but as Schiffner says, if the inflorescence and the other differences are found, after a more extended examination, not to be constant, the plant would be relegated to varietal rank. *E. hyalinus* varies a good deal in the size of its cells, but they are exceptionally large and with large trigones in the present plant. Schiffner gives a further character, in addition to those mentioned in the description, in the size of cells of the inner layer of the wall of the capsule, these being 20–25 μ broad in *E. paroicus* instead of 15–17 μ in *E. hyalinus*.

There is the advantage in having *E. paroicus* distinguished in that the plant has caused confusion in Britain, where it is perhaps more frequent than elsewhere. Some of the specimens had been named *E. hyalinus* while others have been considered to be *E. obovatus*, which the plant sometimes resembles in appearance as in inflorescence. It is distinguished from the latter by having the bracts united to the perianth as in *E. hyalinus* and by the usually smooth cuticle of leaf, also by the larger cells and larger trigones.

78. Eucalyx hyalinus (Lyell) Breidl.

Jungermannia hyalina Lyell in Hook., Brit. Jung. p. 63 (1814).
Nardia hyalina Carr., Brit. Hep. p. 35 (1874).
Aplozia hyalina Dum., Hep. Eur. p. 58 (1874).
Eucalyx hyalinus Breidl., Mitt. Nat. Ver. Steierm. p. 292 (1893).



1. Fertile stem. 2. Leaf. 3. Cells. 4. Elater and spore. 5. Section through perianth.

Dioicous. In rather large *pale green to yellow-green, glistening* patches, or occasionally purple. Stems to 15 mm long, *prostrate with ascending apex*, little branched, frequently reddish underneath; rhizoids numerous, long, *reddish* or sometimes pale coloured. Leaves obliquely inserted, nearly horizontal in the lower part of the stem, erecto-patent above, *rotundate with broad base*, concave, antically decurrent, the margin somewhat undulate; cells 28–36 μ, seldom to 43 μ, rounded or oval-hexagonal, subquadrate at the margin, walls thin, trigones rather *large*, distinct, *cuticle smooth*. Involucral bracts larger than the leaves, recurved at the apex, undulate at the margin, adnate to the *lower* $\frac{1}{4}$ of the perianth. Perianth ovate, *exserted* $\frac{1}{4}$–$\frac{1}{2}$ beyond the bracts, 4–6-plicate above, the mouth elongate-crenulate. Capsule

oval-globose, reddish-brown. Spores *14–16* μ, brown, granular-papillate. Elaters 9 μ thick, short, rather suddenly attenuate, reddish-brown. ♂ plant more slender, bracts erecto-patent; imbricate, saccate at base; antheridia 2–3, globose, on a very short pedicel.

HAB. On moist soil and rocks on the low ground.

DISTRIB. N. to Shetland, frequent; Ireland. Fr. March–June.

There is a peculiar glistening appearance in the common form of the living plant which distinguishes it. The direction of the leaves on the stem varies greatly. Commonly the lower leaves are almost horizontal, while the upper are erecto-patent and less obliquely inserted, but frequently they are all erecto-patent, and in the upper half of the fertile stem sometimes erecto-appressed. The marginal cells are subquadrate, but do not form a border. The perianth is hidden by the bracts when young, and is sometimes only slightly exserted when mature. The height to which the bracts are adnate to the perianth varies; the lower is often free and the upper adnate to a third, but both may be adnate to about a fourth.

E. hyalinus when typical should not cause a mistake, but wet ground forms of this and of *Aplozia crenulata* and *A. sphaerocarpa* may resemble one another considerably. The present species has generally some reddish rhizoids and a few of the leaves show trigones, though smaller than in the common forms, which will nearly always be sufficient to distinguish it from *A. crenulata*, while *A. sphaerocarpa* can be known by its smaller cells.

The purple colour which *E. hyalinus* sometimes assumes is not confined to any particular form.

Var. *heteromorpha* Gottsche is smaller than the type and has the perianth more exserted and almost free from the bracts. This variety has not yet been recorded from Britain.

XXIV. APLOZIA Dum.

Jungermannia sp. L., Sp. Pl. (1753)?
Jungermannia Sect. *Aplozia* Dum., Syll. Jung. p. 47 (1831).
Aplozia Dum., Hep. Eur. p. 55 (1874).

Plants medium sized or small, caespitose. Stem prostrate or ascending, seldom erect, with rhizoids, simple or slightly branched, the branches proceeding from the postical angle of the leaves; often with one, rarely two, innovations from beneath the perianth. Leaves alternate, obliquely inserted, succubous, *round, ovate or oblong. Underleaves absent. Involucral bracts resembling the stem leaves. Perianth free* or slightly concrete at the base with the involucral bracts, *longly exserted*, usually ovate to clavate, plicate with a conical apex, or cylindrical and suddenly contracted into a tubular beak. Calyptra

free. Capsule generally longly pedicellate, the wall of two layers of cells, the outer with nodular thickenings, the inner with numerous semi-annular thickenings. Elaters bispiral. Androecia terminal or at the middle of the stem in dioicous species; bracts saccate, otherwise resembling the leaves; antheridia 1–3.

Some authors retain the name *Jungermannia* for this genus while others employ it for *Lophozia*. The confusion is owing to Dumortier having transposed the name from one genus to the other. Schiffner pointed out that none of the species which Linnaeus placed under *Jungermannia* would come under any modern acceptation of that name. He therefore gave up *Jungermannia* altogether as a generic name, and since then the tendency has been to follow him in this.

The entire-leaved hepatics, comprising *Alicularia*, *Eucalyx* and *Aplozia*, are sometimes very puzzling when sterile. Typical forms of the various species are usually quite easily separated, but aquatic forms, which may deviate greatly from the type in vegetative characters, require careful discrimination in several cases. The form of the leaves in the section *Luridae* of *Aplozia* will distinguish them from the others, the presence of underleaves will separate *Alicularia*, and the colour of the rhizoids will in most cases allow *Eucalyx* to be known, but in several instances the cell structure must be relied on, either by itself or combined with indications of other distinguishing characters.

1 { Leaves round or broader than long 2
  { Leaves longer than broad 4

2 { Marginal cells of leaf, or of involucral bracts at least, about 2–3 times as large as the next inner row and forming a distinct border of thick-walled cells ..... 79. *crenulata*
  { Marginal cells only slightly or not larger than the next inner row 3

3 { Cells of leaf without trigones; dioicous ..... 80. *caespiticia*
  { Cells of leaf with trigones; paroicous ..... 81. *sphaerocarpa*

4 { Leaves oblong-quadrate to oblong-ovate, cells with rather large trigones; perianth cylindrical, smooth, depressed at apex ..... 87. *lanceolata*
  { Leaves ovate-oval to cordate; cells without or with minute trigones; perianth usually plicate, not depressed at apex 5

5 { Leaves broadly cordate 6
  { Leaves oval to oblong-ovate 7

6 { Plant large, to 8 cm long, perianth fusiform; dioicous ..... 82. *cordifolia*
  { Plant very small, 6–1 cm long, perianth ovate to oblong-ovate; paroicous ..... 86. *Schiffneri*

7 { Paroicous; perianth usually fusiform, apex narrow, acute; flagella none or few ..... 85. *pumila*
  { Dioicous; perianth pyriform or oblong-ovate, apex truncate, flagella usually numerous 8

8 { Plant small, blackish-green; leaf-cells 21–28 μ ..... 84. *atrovirens*
  { Plant larger, usually pale green; leaf-cells 26–35 μ ..... 83. *riparia*

Subgen. **Euaplozia** Schiffn.

Euaplozia Schiffn. in Engl. & Prantl I 3 p. 82 (1893).

Perianth with a conical, pointed apex, plicate in the upper part.

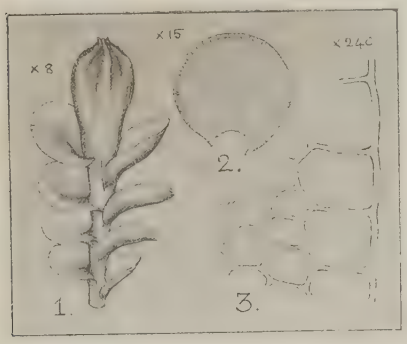
Sect. **Typicae** Schiffn.

Euaplozia Sect. I *Typicae* Schiffn. in Engl. & Prantl I 3 p. 82 (1893).
Subgen. *Eu-Haplozia* K. Müll., Rabh. Krypt. Fl. I p. 538 (1909).

Plants pale green to brown. Leaves rotund. Perianth somewhat laterally compressed, with a median antical keel, 4–5-angled above, the mouth frequently contracted into a short, tubular beak.

79. **Aplozia crenulata** (Sm.) Dum.

Jungermannia crenulata Sm., Eng. Bot. *pl.* 1463 (1805).
Nardia crenulata Lindb., Bot. Notis. p. 167 (1872).
Aplozia crenulata Dum., Hep. Eur. p. 57 (1874).

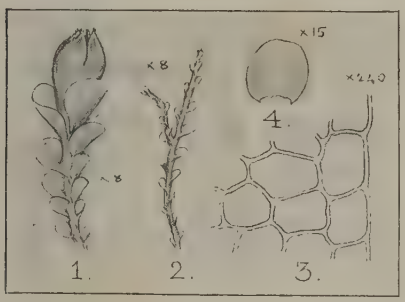


1. Fertile stem. 2. Leaf. 3. Cells.

Dioicous. In *brownish-red*, or more rarely green, thin and compact patches. Stems to 12 mm long, prostrate and with ascending apex, flexuous, usually brown on the ventral side, sometimes with a few small-leaved innovations; rhizoids numerous, colourless or brownish-yellow. Leaves thick, closely imbricate, especially above, obliquely inserted, suberect to erect and slightly secund, increasing in size towards the perianth, *orbicular*; cells 27–34 μ, rounded-polygonal, *walls slightly and equally thickened*, seldom with small trigones, the *marginal row of cells about 2–3 times as large as the next row*, quadrate with thick walls, *forming a distinct border*; cuticle finely hyaline-punctate. Involucral bracts larger than the leaves, erect and almost appressed to the perianth, frequently adnate to it on one side and to the occasionally occurring suborbicular or lingulate bracteole. Perianth exserted about $\frac{1}{2}$ beyond the bracts, *generally tinged with red*, ovate or narrowly oblong, 4- or occasionally 5-plicate, *the folds prominent*, smooth or sometimes slightly crenulate, and extending almost *from the base*, the apex of perianth rarely forming a short tube, the mouth crenulate. Capsule oval-rotund. Spores 13–16 μ, pale reddish-brown, finely granulate. Elaters 7 μ thick, dark reddish-brown. Male plant more slender, bracts in 3–8 pairs at the middle or apex of the stem, imbricate, ventricose, antheridia 1–2.

var. **gracillima** (Sm.) Heeg, Die Leb. Niederöster. p. 81 (1893).

Jungermannia gracillima Sm., Eng. Bot. nr 2238 (1805)
Jungermannia crenulata β *gracillima* Hook., Brit. Jung. nr 37 (1813).
Nardia gracillima Lindb., Hep. in Hib. lect. p. 530 (1875).
Nardia crenulata var. *gracillima* Lindb., Musc. Scand. p. 8 (1879).



1. Fertile stem. 2. Stem with innovations. 3. Cells. 4. Leaf.

Smaller than the type, green or reddish, *with numerous innovations having small and distant leaves*, the marginal row of cells *thin-walled, not or hardly larger than the internal cells* and not forming a border or occasionally an indistinct one in some leaves, but with the border usually distinct in the involucral bracts; angles of perianth smooth or nearly so, calyptra rose-coloured.

forma **tuberculata** Schiffn., Krit. Bem. in Lotos no. 8 p. 13 (1901).

Jungermannia crenulata var. *gracillima* Pears., Hep. Brit. Isles p. 302 (1901).

Resembling var. *gracillima* but with the angles of the perianth distinctly and highly tuberculate.

var. **cristulata** (Dum.) Massal., Rep. Ep. Ital. p. 20 (1896).

Aplozia cristulata Dum., Hep. Eur. p. 57 (1874)

As in the type and with the marginal row of cells large and distinct; angles of perianth distinctly and highly tuberculate.

var. **inundata** (Schiffn.) Macv.

Nardia crenulata var. *inundata* Schiffn., Verh. der k. k. zort. bot. Ges. in Wien p. 417 (1904). Husnot, Hep. Galliae exs. nr. 182 B.

Sterile. In extensive thin, flat, *yellowish-green* patches, *frequently submerged*. Stem to 5 cm long, thin, leaves *distant* or occasionally subimbricate, spreading, *broader than long*, cells generally *smaller* than in the type, the marginal cells rarely larger than the internal cells and *never forming a distinct border*.

Hab. Moist soil on banks, footpaths and roadsides. Var. *inundata* in shallow sandstone depressions.

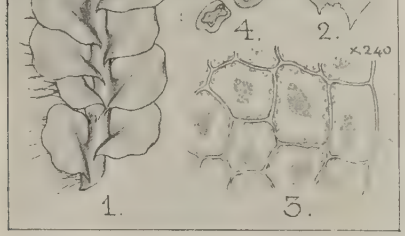
Distrib. N. to Shetland, frequent; Ireland. Var. *inundata*, near York (*Wm. Ingham*). Fr. March–June.

A. crenulata and its varieties can be generally distinguished from all our other round leaved species by the cell-walls of leaf being equally thickened; seldom are trigones developed and they are very small when present. The distinct border of cells in the type may also occur in the leaves near the perianth in the var. *gracillima;* the cells comprising this row are about two to three times as large as the next inner row and give a well-marked character. Small-leaved innovations are scarce or absent in the tpyical plant, but are numerous in the var. *gracillima;* the small leaves are frequently nearly transverse and concave, and are sometimes oblong, especially on the younger parts of the innovation. Intermediate forms are to be found, and all the distinctive characters are subject to variation; yet the variety occurs independently of the type and in some localities is the only form which is found; it is also nearly always confined to the low ground, while the type ascends for a short distance up the hills. This variety is one of our smallest plants. The f. *tuberculata* is frequent, but the var. *cristulata* is uncommon in Britain. The var. *inundata* is unlike the type, but the absence of underleaves and of trigones should enable it to be recognised.

Alicularia scalaris has some resemblance to the present plant in habit and colour, but it has underleaves and a distinct cell structure, as well as highly adnate bracts. *Eucalyx hyalinus* has generally reddish rhizoids, and the leaf-cells have distinct trigones.

80. Aplozia caespiticia (Lindenb.) Dum.

Jungermannia caespiticia Lindenb., Hep. Eur. p. 67 (1829).
Aplozia caespiticia Dum., Hep. Eur. p. 61 (1874).
Solenostoma caespiticia Steph., Spec. Hep. II p. 57 (1901).



1. Stem with leaves. 2. Leaf. 3. Cells. 4. Gemmae.

Dioicous. *Small and tender.* In small dense patches or less commonly gregarious, pale green to *pale yellow-green* in colour. Stems 3–4·5 mm long, usually simple but frequently innovating from below the perianth, prostrate below, ascending to erect above; rhizoids long and colourless, numerous to apex of stem. Leaves obliquely inserted, imbricate, *erecto-appressed* and slightly concave *in the fertile plant*, rotund to subreniform, apex sometimes emarginate, the antical margin slightly decurrent; cells at middle of leaf 32–42 μ in diam., polygonal, *the walls very thin, trigones absent*, marginal row of cells quadrate with somewhat thickened walls, and forming a more or less distinct border; *cuticle smooth.* Underleaves absent Involucral bracts larger than the leaves, embracing the perianth, the margin frequently sinuate; bracteole ovate to lanceolate, or absent. Perianth large, exserted

half beyond the bracts, oblong-ovate, obtusely 4–5-plicate *in the upper part*, contracted into a small and shortly tubular, crenulate mouth. Capsule spherical, reddish-purple, pedicel short. Spores 12–16 μ, pale red, nearly smooth; elaters bispiral reddish-purple. Male bracts in several pairs, transversely inserted, erecto-patent, rather smaller and more concave than the leaves, the antical margin frequently with a broad tooth; antheridia usually single, globose, pedicel very short. Gemmae roundish-quadrate, more rarely 3-angled, 1-celled, very numerous *in a large and conspicuous, brownish-green, globular mass, closely invested with leaves, at the apex of the swollen stem from which they arise endogenously.*

HAB. Moist clayey or loamy soil at the side of ditches, heathy places, etc.

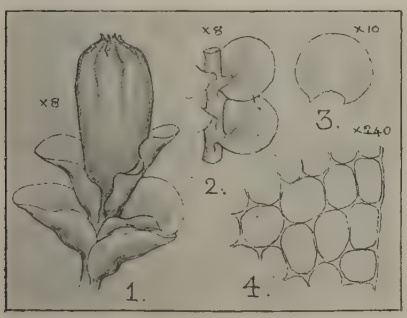
DISTRIB. Isle of Wight; Surrey (*H. H. Knight*). Fr. April–June.

The pale yellowish-green colour and the large and very thin-walled leaf cells distinguish this small species from any likely to be confused with it. It more resembles *A. crenulata* than any other, but that species has thickened cell-walls, the marginal row much so and forming a distinct border; its var. *gracillima* has many small-leaved innovations; in both the type and variety the cuticle is minutely striate-verruculose and the perianth is sharply quadrangular almost to the base. *A. sphaerocarpa* is paroicous and the leaf-cells have distinct trigones; it is also a larger plant and frequently brownish.

When gemmae are present, the plant cannot be mistaken, as the large, globular heads closely invested with leaves are distinctive. Herr Buch has investigated the gemmae formation of this species and finds that they arise endogenously from the swollen apex of the stem.

81. Aplozia sphaerocarpa (Hook.) Dum.

Jungermannia sphaerocarpa Hook., Brit. Jung. *pl.* 74 (1815).
Jungermannia scalariformis Nees, Eur. Leb. II p. 463 (1836).
Aplozia sphaerocarpa Dum., Hep. Eur. p. 61 (1874).



8 1. Fertile stem. 2. Sterile stem with leaves. 3. Leaf. 4. Cells.

Paroicous. In pale green or brown compact tufts. Stems 1–3 cm long, *erect or ascending*, simple, frequently with small leaved innovations; rhizoids numerous, to near apex of stem, long, colourless or sometimes violet near the ends. Leaves *soft*, distant or approximate, obliquely inserted below, nearly transverse above, semi-amplexicaul, concave, *orbicular* or sometimes retuse at apex, the antical margin

decurrent; erecto-patent in the fertile plant, in the sterile plant squarrose patulose; cells 25–35 μ, smaller towards the margin, 4–6-angled, the walls thin, *trigones* usually small but *distinct*; marginal row of cells quadrate, not or *hardly larger than the next row*, frequently hyaline-brown, forming a somewhat distinct border; *cuticle smooth*. Subinvolucral bracts in few pairs, hardly larger than the leaves, slightly saccate; antheridia 2–3, pedicel short. Involucral bracts broader, erecto-patent. Perianth *obovate or clavate*, $\frac{1}{2}$–$\frac{2}{3}$ exserted, 3–6 but mostly *4-angled above*, *smooth below*, the apex shortly tubular, mouth crenulate. Capsule spherical, longly pedicellate. Spores 16–18 μ, occasionally to 20 μ, *reddish*-brown, finely papillate. Elaters 8–10 μ thick, reddish-brown.

var. **nana** (Nees) K. Müll, Krypt. Fl. I p. 548 (1909).

Jungermannia nana Nees, Eur. Leb. I p. 317 (1833).
Aplozia nana Breidl., Die Leb. Steiermark. p. 304 (1894).
Jungermannia sphaerocarpa var. *lurida* Pears., Hep. Brit. Isles p. 298 (1901).

Small. In *small compact tufts* on moist soil, *dark reddish-brown or blackish-brown*, seldom dark reddish-green in colour. Stems 1–2 cm high, erect, frequently in great part buried in the soil; rhizoids usually numerous, especially on the fertile stems. Leaves on the fertile stems *erecto-appressed*, commonly broader than in the type; on the sterile stems patent or erecto-appressed; cells thin-walled and with small trigones. Involucral bracts *broad*, *appressed*. Perianth sharply 4-angled, *with a distinct apiculus*.

Hab. Sides of streams and among wet rocks, chiefly subalpine. Var. *nana* in the alpine region, ascending to 3000 ft. alt.

Distrib. N. to Caithness, uncommon; Ireland. Var. *nana*, Wales and Highlands of Scotland, rare; Ireland? Fr. April–July.

Sterile plants have sometimes much the appearance of aquatic forms of *Eucalyx obovatus* in which the rhizoids are in great part colourless, but even in extreme forms of the latter the violet colour is more in evidence than in the present plant, and it has rather numerous leafless flagella; also in *A. sphaerocarpa* the leaves are more nearly rotund, there are distinct trigones and the cuticle is smooth except in the basal cells. It is a larger plant than *A. crenulata* and has distinct trigones; also the marginal row, though frequently distinct, is not composed of cells which are two to three times as large as the next inner row; the perianth is of a different shape, more exserted, and the inflorescence is paroicous.

The remains of the antheridia can generally be found in this species in the axils of the bracts below the perianth, but the antheridia will only as a rule be found in the younger state of the inflorescence situated on a branch.

The var. *nana* varies considerably in size. When it occurs on the summits of our hills it is a small, very dark coloured plant, with the stems mostly buried

in the soil. There is some doubt whether Dumortier's *Aplozia lurida* refers to this variety or to *A. scalariformis*, or includes both.

Jungermannia scalariformis Nees *(Haplozia Breidleri* K. Müll.) is allied to the var. *nana* but has larger leaf-cells, 35–48 μ at the middle of the leaf, valves of capsule yellowish-brown by transmitted light instead of reddish-brown, and with spores rather larger and yellowish-brown.

Jung. Goulardi Husnot hardly differs from the type. It is a rather small form with the mouth of perianth most frequently 3-lobed.

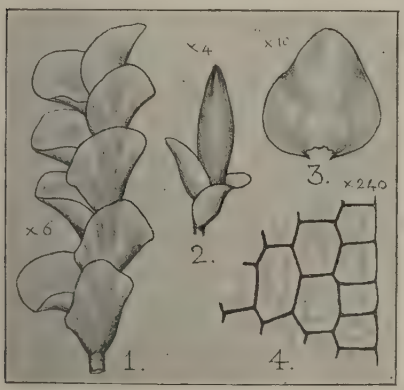
Sect. **Luridae** Spruce

Jungermannia Sect. *Luridae* Spruce, Hep. Amaz. et And. p. 509 (1885).
Euaplozia Sect. II *Luridae* Schiffn. in Engl. and Prantl I 3 p. 82 (1893).
Subgen. *Luridae* K. Müll., Rabh. Krypt. Fl. I p. 539 (1909).

Plants olive-green. Leaves ovate to oblong-cordate. Perianth frontally compressed with a median antical furrow in place of a keel, plicate above, the apex usually conical.

82. **Aplozia cordifolia** (Hook.) Dum.

Jungermannia cordifolia Hook., Brit. Jung. *pl.* 32 (1812).
Aplozia cordifolia Dum., Hep. Eur. p. 59 (1874).



1. Sterile stem. 2. Perianth. 3. Leaf. 4. Cells.

Dioicous. In *large*, *spongy purple-black*, or more rarely olive-green *tufts*. Stems to 8 cm long or more, *erect or suberect*, flexuose, simple or branched, frequently with stolons at base; rhizoids colourless or brown, *scarce*, *almost absent above*. Leaves *flaccid*, distant below, subimbricate or approximate above, *cordate-ovate*, *embracing the stem* with a *narrow*, *nearly transverse* attachment, concave, *erecto-patent*, very slightly decurrent antically; cells 28–36 μ, smaller and subquadrate towards the margin, 4–6-angled, walls thin, firm, usually *reddish-brown*, *trigones none*; cuticle *finely striate-verruculose* or sometimes nearly smooth. Involucral bracts erecto-patent. Perianth extending $\frac{1}{3}$–$\frac{1}{2}$ beyond the bracts, *fusiform*, slightly plicate at the

apex, otherwise *smooth*, the cells elongated, reddish, mouth crenulate. Capsule oblong-oval, purple-black. Spores 19–24 μ, yellow-brown, finely granulate. Elaters 100–140 μ long, reddish-brown, laxly bispiral, slightly attenuate at one end. Male plant smaller, bracts in 10–12 pairs, imbricate, *erect*, concave, saccate at base; antheridia generally solitary, oval-globose, pedicel short.

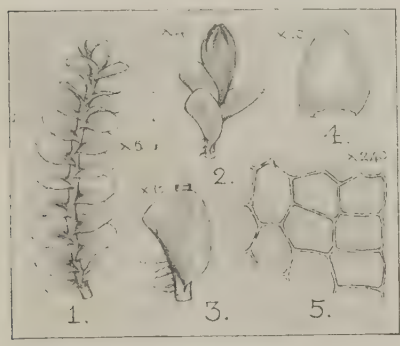
HAB. Springs, rocks in streams, and in marshy ground, subalpine and alpine, ascending to 3600 ft. alt.

DISTRIB. Wales to Ross, uncommon; Ireland. Fr. June–July.

Can only be confused with large sterile forms of *A. riparia*. The flaccid leaves, cordate at base but with a narrow attachment, embracing the commonly almost naked stem, are sufficient in most cases to distinguish the present plant; in addition, as pointed out by Evans, the cell-walls are usually dark coloured, trigones are absent and the cuticle is generally striate-verruculose, while in *A. riparia* the walls are colourless, small trigones can usually be seen and the cuticle is smooth. The common form of *A. cordifolia* is very flaccid, so much so that the leaves recover their shape with difficulty after being dried. The fusiform, nearly smooth perianth is unlike that of *A. riparia* and bears no resemblance to that of any of the preceding species; it is frequently found to be broken off about the middle. Although this species is often sterile, fruit occurs in abundance on our higher hills in places where the plant forms large spongy masses, especially in springs.

83. **Aplozia riparia** (Tayl.) Dum.

Jungermannia riparia Tayl., Ann. and Mag. Nat. Hist. p. 88 (1843).
Jungermannia tristis Nees, Eur. Leb. II p. 461 (1836).
Aplozia riparia Dum., Hep. Eur. p. 63 (1874).



1. Sterile stem. 2. Perianth. 3, 4. Leaves. 5. Cells.

Dioicous. In *yellowish-green* or olive-green patches. Stems 1–2 cm long, prostrate with ascending apex or suberect, simple or slightly branched, with innovations from below the ♀ inflorescence, *stolons usually several*; rhizoids long, brown or colourless, to *apex of stem*. Lower leaves approximate, oblique and flat; more imbricate and more transverse, concave and half embracing the stem above in the fertile plant. *horizontal or patent*, *broadly*

ovate or oblong with a *broad* base. Cells 26–35 μ, 5–6-angled, mostly oblong, rather smaller and subquadrate near the margin, walls *colourless*, thin, very slightly thickened at the angles, the *trigones being minute* or occasionally absent; cuticle usually *smooth*. Involucral bracts erecto-patent, the upper half patent or squarrose. Perianth *clavate or pyriform*, extending $\frac{1}{2}$–$\frac{2}{3}$ beyond the bracts, the upper third *strongly 5–6 plicate*, cells not elongated, colourless, mouth truncate and lobed, finely denticulate. Capsule broadly oval. Spores 14–18 μ, pale reddish-brown, finely granulate. Elaters reddish-brown. ♂ bracts in several pairs, hardly imbricate, erecto-*patent*, saccate at base; antheridia generally solitary, oval-globose, pedicel short.

var. **rivularis** Bern., Cat. Hép. Suisse p. 59 (1888); K. Müll., Krypt., Fl. I p. 561 (1909).

Aquatic, resembling in appearance *Chiloscyphus polyanthus* var. *rivularis*. Larger than the type, in dark green tufts; *leaves broad*, widely spreading, nearly flat; perianth *ovate-prismatic*, *deeply* 5-plicate, one fold being dorsal, two being ventral, and one on each side.

Hab. Among wet rocks, chiefly subalpine, ascending to 3200 ft. alt. Var. *rivularis*, submerged in streams.

Distrib. N. to Shetland, frequent; Ireland. Var. *rivularis*, widely distributed but rare. Fr. March–Aug.

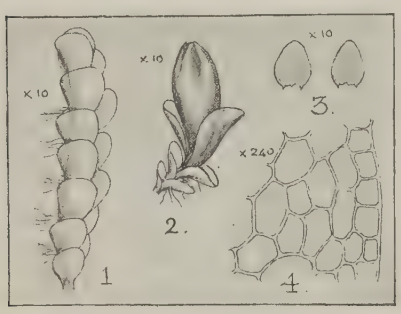
Is very variable but is generally of a characteristic dirty green colour. Inflorescence is nearly always present, perianths are common, and even in small depauperate forms, male bracts are very frequently to be found. The common presence of perianths makes the plant generally to be recognised without difficulty, as no other entire leaved species has them at all of the same shape except *A. atrovirens;* they vary from being pyriform to oblong-ovate, but are always plicate at the upper part. Dark-coloured sterile forms may be known from *Eucalyx obovatus* by the colourless rhizoids, the minute trigones, smooth cuticle and generally by the shape of the leaf.

The var. *rivularis* is the largest form of the species; it is submerged on stones and rocks in streams and is nearly always sterile, but perianths are present if the plant rises above the surface. A smaller plant than this but larger than the type is f. *potamophila* Bern., *Cat. Hép. Suisse* p. 58, with the leaves frequently erecto-patent and concave, the perianth oblong, narrowed at the base and apex and 5-plicate in the upper part, the folds being as in the var. *rivularis;* it is found at the side of streams and among wet rocks, and passes into the type as it probably also does on the other side into the var. *rivularis*. These larger forms are sometimes confused with *A. cordifolia*, the distinctions being given under that species.

A. riparia is apparently a more common plant in Britain than on the Continent and is less calcicolous.

84. Aplozia atrovirens (Schleich.) Dum.

Jungermannia atrovirens Schleich. in Herb.
Jungermannia pumila var. *notha* Gottsche in Gott. and Rabh., Hep. Eur. Exs. Nos 396–398 (1867).
Aplozia atrovirens Dum., Hep. Eur. p. 63 (1874).
Aplozia atrovirens a. *Schleicheri* Bern., Cat. Hép. Suisse p. 60 (1888).



1. Sterile stem. 2. Perianth (var. *sphaerocarpoidea*). 3. Leaves. 4. Cells.

Dioicous. Minute; in depressed *olive-green* patches. Stems *3–6* mm long, slightly branched, innovating from below the ♀ inflorescence, ascending or suberect from a creeping base, *stolons usually several*; rhizoids brownish, numerous to near apex of stem. Leaves ·35–·56 mm long, imbricate, spreading and oblique below, *erecto-patent*, almost transverse and half embracing the stem above, *concave, ovate or oval.* Cells *21–28* μ, smaller towards the margin, 5–6-angled, the marginal row quadrate, walls slightly thickened, *trigones generally distinct*; cuticle *striate-verruculose.* Involucral bracts half embracing the perianth, erect or the upper half spreading. *Perianth ovate to oblong-ovate*, smooth below, slightly 5-plicate above, the mouth *truncate*, shortly lobed and finely denticulate; the cuticle striate-verruculose, trigones distinct. Capsule oblong-oval, purple-brown. Spores 14–17 μ, reddish-brown, finely granulate. Elaters short, sometimes furcate, shortly attenuate, reddish-brown. ♂ bracts in several pairs, imbricate, *erect* with the apex patulous, saccate, *concave to apex*; antheridia 1–2.

var. sphaerocarpoidea (De Not.) Massal., Ann. Inst. Bot. di Roma viii p. 8 reprint (1888).

Jungermannia sphaerocarpoidea De Not., Mem. Acc. Tor. ser. 2 Vol. 18 p. 493 (1859).
Jungermannia riparia var. *minor* Carr. et Pears., Hep. Brit. Exs. nrs. 168 and 169 (fide Massalongo).
Aplozia atrovirens var. *riparioides* Bern., Cat. Hép. Suisse p. 60 (1888).

Larger than the type, leaves to 1 mm long, generally more patent and more convex, involucral bracts patent except near the base, *perianth longer*, sometimes broadest above the middle, *deeply* 5-plicate,

the plicae extending further down, the mouth more distinctly lobed, the pedicel of capsule shorter and exserted for about 2 mm only.

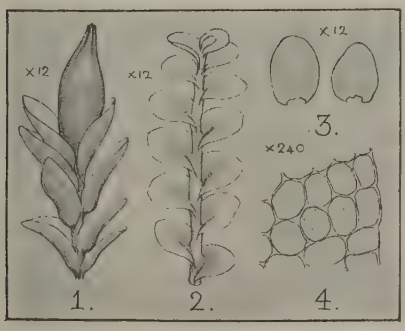
HAB. Moist or wet soil among rocks, ascending to 3200 ft. alt.

DISTRIB. Hereford to Shetland, rare. Fr. Mar.–June.

All the British specimens which I have seen belong to the var. *sphaerocarpoidea*. It resembles *A. pumila* in appearance, but as that species always has perianths, so far as I have seen, plants without inflorescence might almost with safety, though somewhat unsatisfactorily, be referred to the present plant. A character which is of assistance is the presence of stolons; these are generally to be found in *A. atrovirens* while they are rare in *A. pumila*. It is seldom that the dioicous inflorescence cannot be made out in the former, and this will distinguish it at once from the other; the perianths are also of quite different shape. It is more difficult to distinguish it from small forms of *A. riparia*, though it is seldom that the latter is small enough to cause confusion; *A. atrovirens* is olive-green, leaves more oval, cells smaller, perianth more ovate and truncate, and the bracts more concave; the smaller leaf-cells is the most generally useful character. Bernet and K. Müller consider that they cannot always be distinguished from one another. I am doubtful if this view is correct, but on the other hand I have not been able to discover the limits, if any, between them.

85. Aplozia pumila (With.) Dum.

Jungermannia pumila With., Arr. Brit. Pl. p. 866 (1776).
Jungermannia Zeyheri Hüben., Hep. Germ. p. 89 (1834).
Aplozia pumila Dum., Hep. Eur. p. 59 (1874).



1. Fertile stem. 2. Sterile stem. 3. Leaves. 4. Cells.

Paroicous. Small; in depressed olive-green to nearly black patches. Stems 5–10 mm long, simple or branched, frequently with innovations from below the ♀ inflorescence, ascending or suberect from a creeping base, *stolons none or few*; rhizoids brownish or colourless, numerous to near apex of the stem. Leaves distant, oblique, nearly horizontal, *oval below*; approximate or subimbricate, more transverse, *ovate-oval above*. Cells 23–30 μ, sometimes to 35 μ, 5–6-angled, rather smaller and subquadrate towards the margin, walls thin, trigones small and distinct or absent; cuticle striate-verruculose. *Subinvolucral bracts 2–3*

pairs, larger than the leaves, erect with the upper part patent to squarrose, nearly transversely inserted, embracing the stem, ovate, concave, *saccate at base*; involucral bracts similar, embracing the lower third of the perianth; antheridia generally solitary, oval-globose, pedicel very short. *Perianth fusiform*, nearly *smooth*, slightly plicate only near the *acute apex*, the mouth crenulate with lengthened cells; the cuticle striate-verruculose, trigones distinct. Capsule oval, dark brown, pedicel short. Spores 16–20 μ, brownish-yellow, finely granulate. Elaters slightly attenuate, reddish-brown.

var. **rivularis** Schiffn, Lotos no. 7 p. 326 (1900).

Aplozia rivularis Schiffn., Krit. Bemerk. in Lotos p. 2 (1911).

Subaquatic or aquatic; *larger than the type*, resembling in size small forms of *A. riparia*; stems to nearly 2 cm long, frequently with stolons, leaf-cells rather larger, *perianth considerably larger and cylindrical-clavate*, more distinctly plicate towards the apex.

HAB. Moist gravelly soil and wet rocks, ascending to 2000 ft. alt.

DISTRIB. N. to Orkney, uncommon; Ireland. Var. *rivularis*, rare. Fr. May–Oct.

As the smooth, fusiform perianths are always present, this small species is usually easily identified; also the bracts below the perianth are saccate for a considerable time after the antheridia have disappeared, thus giving evidence of its being paroicous. As with other paroicous species, it is frequently necessary to dissect the young branches in order to find both male and female inflorescence.

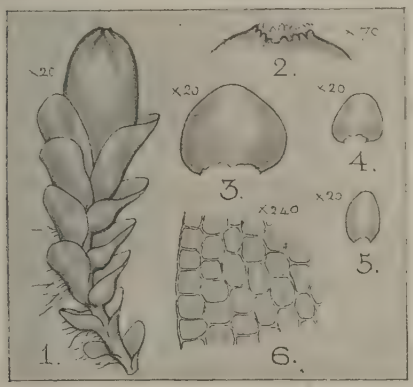
The var. *rivularis* may be a distinct species, as Schiffner has recently preferred to consider it, and this seems to be the view of Pearson in *Journ. Bot.* p. 349, 1911; but I am inclined to regard it as a subaquatic and aquatic form of *A. pumila*. This species varies considerably in size and habit and in the shape and size of the perianth. When it grows in moist soil it is a small plant with small and slender perianths, but it becomes larger and has larger perianths when on wet rocks. I do not find the much larger leaf-cells of the variety, which Schiffner gives as one of the principal distinguishing characters, to be a constant difference, nor the more spreading involucral bracts. Schiffner gives in addition the capsule of the variety to be rather larger, with the cells of the wall narrower and the spores smaller, the latter being about 16 μ instead of about 21 μ in *A. pumila*; but the size of the spores varies somewhat in *A. pumila* and averages less than 21 μ in the specimens which I have examined.

The shape of the perianth, as well as the paroicous inflorescence, will readily separate the var. *rivularis* from *A. riparia*, as the perianths of the former are by no means always clavate cylindrical, but are frequently indistinguishable in form from what may be seen in the typical plant.

86. Aplozia Schiffneri Loitlesb.

Aplozia Schiffneri Loitlesb., Verh. der k. k. Zool. bot. Ges. in Wien p. 482 (1905); Schiffn., Hedwigia. p. 184 (1909).

Haplozia Schiffneri K. Müll., Krypt. Fl. I p. 570 (1909).



1. Fertile stem. 2. Mouth of perianth. 3. Perigonial bract. 4. Leaf from fertile stem. 5. Leaf from sterile stem. 6. Cells.

Paroicous. Small. In small, compact, depressed, dark green patches. Stems 6–10 mm long, prostrate with the apex ascending, simple or nearly so but frequently with innovations; rhizoids long, colourless, numerous to near apex of stem. Leaves on the fertile stems small, ovate and patent below, in the upper part larger, imbricate, erecto-patent and concave, *broadly cordate*, antically secund. *Cells 16–21 μ*, 5–6-angled, the walls thin, trigones minute; cuticle finely striate-verruculose. Subinvolucral bracts in 3–4 pairs, imbricate, embracing the stem, very concave, slightly saccate at base, erecto-patent or erect, resembling the leaves in shape but larger; involucral bracts somewhat embracing the perianth but with the upper third frequently patent. Perianth exserted for half its length, or further, beyond the bracts, *ovate to oblong-ovate*, becoming cylindrical-clavate, broadest slightly above the middle, *rounded at the apex, suddenly contracted at the mouth*, somewhat frontally compressed, the upper third plicate, the mouth crenulate to crenulate-dentate with projecting cells. Capsule almost spherical, dark brown, the pedicel 3–5 mm long. Spores 15–18 μ, yellowish-brown, finely granulate. Elaters to 100 μ long, 7–8 μ thick, reddish-brown, bispiral.

Hab. Moist soil and rocks in the alpine region.

Distrib. Glenbeg, Glenshee, Perthshire, 1879 *(Dr. John Fergusson)*.

This small paroicous species is readily distinguished from *A. pumila* by the shape of the perianth, the upper part not being gradually contracted into a beak. The leaves are also much broader, being cordate at base on the fertile stems and with the cells smaller; they are ovate to oval on the sterile stems. The cells of the inner layer of the capsule wall are also smaller, being only about half as broad as in *A. pumila*.

A. sphaerocarpa var. *nana* has a very different perianth as well as different shaped leaves, etc. *A. atrovirens* is dioicous and has larger leaf-cells.

A. Schiffneri is at present only known otherwise from a few localities in Austria and Switzerland, but it will most probably be found to be widely distributed. Schiffner has confirmed the identification of the Scottish specimen.

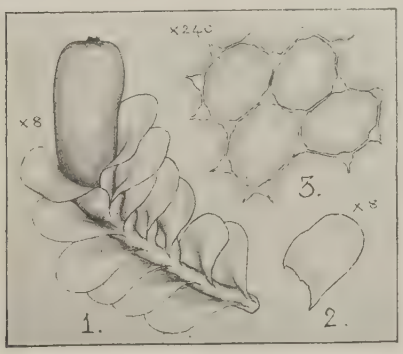
Subgen. Liochlaena (Nees) Schiffn.

Liochlaena Gen. Nees, G. L. N. Syn. Hep. p. 150 (1844).
Liochlaena Schiffn. in Engl. and Prantl I 3 p. 82 (1893).

Leaves oblong-oval to oblong-rectangular. Perianth cylindrical, without angles, not plicate, the apex depressed and with the mouth suddenly contracted into a short tubular beak.

87. Aplozia lanceolata (Schrad.) Dum.

Jungermannia lanceolata Schrad., Samml. Lief. 2 p. 4 (1797).
Liochlaena lanceolata Nees, Syn. Hep. p. 150 (1844).
Aplozia lanceolata Dum., Hep. Eur. p. 59 (1874).



1. Fertile stem. 2. Leaf. 3. Cells.

Paroicous, rarely monoicous. In extended flat bright pale-green to brown patches. Stems to 3 cm long, thick, *prostrate*, irregularly branched, rhizoids brownish, numerous to apex of stem. Leaves imbricate, obliquely inserted, the antical margin *decurrent*, *oblong-oval to oblong-rectangular*, *convex* with the upper third reflexed, patent to *horizontal*. Cells 35–44 μ, rounded-polygonal, oblong and lengthened at base, thin-walled, *trigones rather large*, *distinct*, chlorophyll granules numerous, cuticle coarsely verrucose. Subinvolucral bracts 2–3 pairs, nearly transverse, saccate at base, resembling and hardly larger than the leaves; involucral bracts similar, rather larger, erect at base, squarrose patulous above; antheridia 1–3, nearly globose, pedicel short. *Perianth cylindrical-clavate*, incurved, *smooth*, *apex truncate and depressed*, the mouth small, *tubular*, crenulate. Capsule oval, pedicel long. Spores 10–13 μ, tetrahedral, yellowish-brown, nearly smooth. Elaters reddish-brown.

Hab. Wet rocks and on moist soil in shady places.

Distrib. From Westmoreland southward; very rare. Fr. March–April.

When perianths are present this species cannot be mistaken. The oblong-rectangular or oblong-oval leaves should allow sterile plants to be distinguished from any other member of the genus. It is more like *Pedinophyllum inter-*

ruptum, but that species has always some underleaves to be seen, leaves frequently emarginate, antical margin very slightly decurrent, cell structure different, rhizoids fewer, etc.

Breidler describes gemmae in his var. *prolifera*; they are pale green, round or ellipsoid, 2-celled, on thin small-leaved shoots 2–5 mm long. This variety has not been recorded from Britain.

XXV. JAMESONIELLA (Spruce) Schiffn.

Jungermannia Subgen. *Jamesoniella* Spruce, Journ. Bot. p. 26–29 (1876).
Jamesoniella Schiffn. in Engl. and Prantl, Die Nat. Pflanzenf. I 3 p. 82 (1893).

Plants rather large to large, often reddish-yellow or purple. Stems usually ascending or erect with the apex incurved, often rigid, with innovations from below the ♀ inflorescence. Leaves alternate, succubous, obliquely inserted and *almost semi-amplexicaul*, *erecto-connivent in the upper part of the stem*, *entire*, ovate to subrotund; cell-walls with often greatly thickened angles. Underleaves absent or minute, except in the involucre. Inflorescence dioicous. Bracts slightly larger than the leaves, *more or less laciniate; bracteole large*, *laciniate*. Perianth when fertile longly exserted, oblong-ovate, deeply 6–10-plicate in the upper part, somewhat contracted at the wide mouth. Male bracts terminal, ventricose, with an inflated antical lobule.

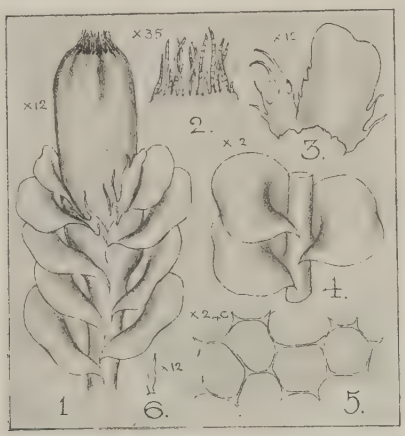
The position of our three species which are at present placed in this genus is somewhat doubtful. Spruce had already remarked in his *Hep. Amaz. et And.* p. 507 "Whether the British *Jung. Carringtoni* Balf. be really a congener of *Jamesoniella colorata* (the typical species) is doubtful, and will probably remain so until fertile plants of the former be found." Only the male plant is, so far, known. *J. subapicalis* and *J. Schraderi*, which Stephani placed in this genus, though as a single species, also differ in some degree from the characteristic members of this exotic genus. They are separated from *Aplozia* by having underleaves and a bracteole, the latter being large, in the involucral bracts not being similar to the stem leaves, but being more or less laciniate or lobed, and in the mouth of the perianth being ciliate or dentate.

1. Stem 5–9 cm long, erect, leaves rotund-reniform, cells 18–34 μ, trigones large and subnodulose ..... 90. *Carringtoni*
   Stem 1–5 cm long, prostrate, or decumbent, leaves oblong or rotund, cells 26–34 μ, trigones small 2
2. Usually in dark green patches on rocks and stones or on wood; mouth of perianth longly ciliate ..... 88. *subapicalis*
   Creeping over Sphagnum; mouth of perianth dentate ..... 89. *Schraderi*

88. Jamesoniella subapicalis (Nees) Schiffn.

Jungermannia autumnalis D. C., Fl. Franc. Supp. p. 202 (1815)?; Pears., Hep. Brit. Isles p. 303 *pl.* 129 (1901).

Jungermannia subapicalis Nees, Eur. Leb. I p. 310 (1833); Limpr., Krypt. Fl. Schles. p. 265 (1876).
Jamesoniella subapicalis Schiffn., Krit. Bemerk. in Lotos p. 12 (1911).



1. Fertile stem. 2. Mouth of perianth. 3. Bract and bracteole. 4. Leaves. 5. Cells. 6. Underleaf.

Dioicous. In dark green or yellow-green flat patches, with frequently a rufescent tinge on the upper parts. Stems 1–3 cm long, prostrate with ascending apex, flexuous or arcuate, simple or branched, branches preceding from the postical angle of the leaves, repeatedly innovant from below the ♀ inflorescence; rhizoids colourless, somewhat numerous to near apex of stem. Leaves *horizontal* or sometimes slightly secund antically and *oblong-oval* in the lower part of stem, *erecto-appressed* and *rotund-oval* above, imbricate, *convex*, entire or *frequently retuse*, decurrent antically; cells 26–34 μ, rounded-polygonal, walls thin, trigones rather small but *distinct;* marginal row small, oblong-quadrate, walls thicker; chlorophyll granules numerous; cuticle almost smooth. Underleaves subulate, erecto-patent, present only in the younger parts, frequently obsolete. Involucral bracts erect with the apex squarrose, oblong to rotund-oblong, the apex entire, retuse or emarginate, generally *with a laciniate tooth* on *one or both sides* near the base; *bracteole large*, *laciniate*, frequently adnate to the inner bract. Fertile perianth longly exserted, *almost cylindrical* but slightly clavate, smooth below, 4–5-plicate near the slightly contracted apex; *mouth longly and unequally ciliate; sterile perianth hardly or slightly exserted, ovate, plicate.* Capsule oval, the wall with four layers of cells, pedicel rather long. Spores 11–15 μ, reddish-brown, finely verruculose. Elaters reddish-brown, laxly bispiral. ♂ bracts in 4–6 pairs, erect, closely imbricate, brown, concave, with 1–2 teeth on the antical margin; antheridia solitary, large, on a rather long pedicel.

Hab. On half buried stones and rocks, stumps and mossy walls in shady places in the subalpine region.

Distrib. Sussex, very rare; Wales to Forfar, rare.

As perianths are commonly present, the long cilia at the mouth render this plant easily known, cilia not being found in our other entire-leaved species; the frequently laciniate teeth at the base of the bracts are also noticeable. The stems are arcuately bent under the sterile perianths, the leaves are convex and are mostly longer than broad. They are frequently distant or approximate on the sterile stems. Underleaves are usually difficult to detect except in the inflorescence, and are variable in shape, being sometimes linear or triangular and with laciniae at the base. The numerous chlorophyll granules render the leaves opaque. The laciniae at the sides of the bracts vary considerably in size and may be absent. The perianths frequently appear as if dorsal on account of the innovations.

The frequently retuse leaves might cause confusion with some forms of *Alicularia scalaris;* but when the leaves are not entire in the latter species, they have a small, round notch as an emargination, and not a broad and shallow one as in this plant. As *J. subapicalis* is sometimes found on stumps, it might perhaps be mistaken for *Odontoschisma denudatum* which grows in similar places, but the latter has flagella and usually gemmiferous apices of the stems, and the cell structure is quite different.

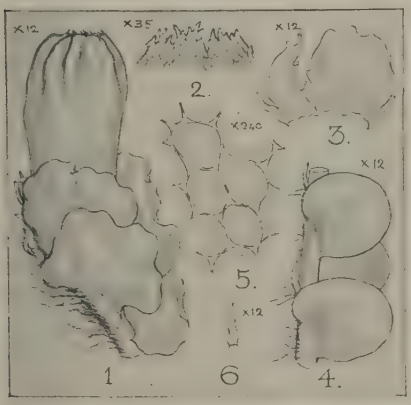
Jung. autumnalis D. C. perhaps included both this species and *J. Schraderi*. The matter, however, is doubtful, and the name is used by authors in different ways, so that it is better discarded.

89. Jamesoniella Schraderi (Nees) Schiffn.

Jungermannia Schraderi Nees, Eur. Leb. I p. 306 (1833); Limpr., Krypt. Fl. Schles. p. 265 (1876).

Jungermannia autumnalis var. *Schraderi* Pears., Hep. Brit. Isles p. 305 *pl.* 130 (1901).

Jamesoniella Schraderi Schiffn., Krit. Bemerk. in Lotos p. 14 (1911).



1. Fertile stem. 2. Mouth of perianth. 3. Bract and bracteole. 4. Stem with leaves. 5. Cells. 6. Underleaf.

Dioicous. In thin *reddish-brown* patches *creeping over* and among *Sphagnum*. Stems to 5 cm long, branched, flexuous. Leaves usually *secund antically*, the upper erecto-patent or appressed, *undulate*, all *rotund* or the lower oblong-rotund, the margin near apex *incurved, not convex;* cells and underleaves as in *J. subapicalis*, trigones small or rather large. Subinvolucral bracts *sinuate-lobate*, *obovate*, but sometimes entire and rotundate; involucral bracts *undulate*, *oblong-obovate to rotund*, *slightly bilobed*, or entire at

the apex, with 1–2 dentate-ciliate teeth on the margin; bracteole broad, variously laciniate. Perianth longly exserted, *oblong-obovate*, smooth below, plicate near the apex, *the mouth dentate*. Antheridia 1–2, shortly pedicellate.

HAB. Creeping over Sphagnum in subalpine peat-mosses.

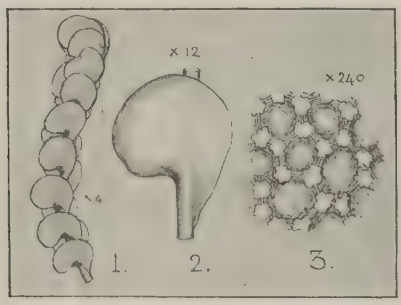
DISTRIB. Westmoreland; Argyll; very rare.

Might readily be overlooked in the field for *Odontoschisma Sphagni*, but the conspicuous flagella of the latter will distinguish it with the lens; the latter has also stiffer, more arcuate stems, longer rhizoids and a distinctly bordered leaf. *Leptoscyphus Taylori* is a larger plant and with very different leaf-cells.

This plant is variously given by authors as a distinct species, a variety of the previous species or merely as a synonym of it. From the few specimens which I have seen, I am inclined to agree with those who consider it specifically distinct. It differs from the other in habit and habitat, leaves broader and not retuse at the apex, subinvolucral bracts broad and sinuate-lobed, and the involucral bracts generally shortly bilobed or sometimes shortly 3-lobed, the perianths more cylindrical at the base, and especially in the dentate and not longly ciliate mouth. The colour of the British specimens is also reddish-brown, unlike that of *J. subapicalis*.

90. Jamesoniella Carringtoni (Balf.) Schiffn.

Adelanthus Carringtoni Balfour MS. in Carr., Trans. Bot. Soc. Ed. p. 378 (1870).
Nardia Carringtoni Carr., Brit. Hep. p, 27 (1874).
Nardia compressa var. *Carringtoni* Lindb., Hep. in Hib. lect. p. 531 (1875).
Jamesoniella Carringtoni Schiffn. in Engl. and Prantl, I 3 p. 83 (1893).



1. Stem. 2. Leaf. 3. Cells.

Dioicous. In *tall, loose pale yellowish-green* tufts. Stems 5–9 cm long, *erect* from a creeping base, slightly circinate at apex, rigid, flexuous, reddish-brown, simple or with a few branches proceeding from the postical angle of the leaves, and with some flagella; rhizoids scarce, almost absent from the erect stems, long and colourless. Leaves *rotund-reniform*, approximate below, subimbricate to imbricate above, *erecto-appressed*, *concave*, antical margin projecting $\frac{1}{3}$ *beyond the stem and longly decurrent*, the postical margin projecting $\frac{2}{3}$ *beyond the stem*, *rounded*, *abruptly* and slightly decurrent;

the whole margin slightly sinuate and occasionally with some cilia-like teeth on the postical portion ; cells 18–24 μ, rounded-hexagonal, smaller towards the margin, a few at base elongate, *trigones very large, subnodulose*, sometimes confluent; cuticle smooth. Underleaves subulate, confined to near apex of the young branches, but most frequently absent. ♂ bracts in 6–10 pairs at apex of stem, rather smaller than the leaves, rotund, concave, saccate at base ; antheridia globose, pedicel short.

HAB. Grassy slopes, rock ledges and among boulders from 1600–2400 ft. alt., very rarely descending to 300 ft. alt.

DISTRIB. Dumbarton to Orkney, frequent in the western Highlands, very rare elsewhere.

This fine plant is perhaps the most easily identified hepatic we have, there being no other tall, erect, pale yellowish species with rounded, erecto-appressed leaves. It is astonishing that it should ever have been confused with *Alicularia compressa*. They grow under quite different conditions and bear no resemblance to each other in colour or texture ; also on closer view, the present plant has the antical margin of the leaf longly decurrent, the leaves not equally projecting on both sides of the stem, and the cell structure very different.

There are occasionally small, variously lobed and spinous-ciliate leaves at the base of the branches; sometimes there are also large and almost lobed, spinous-ciliate leaves near the apex of the stems, but which are apparently unconnected with any inflorescence. The plant has a more pronounced yellow tinge in herbaria than when growing.

This species was first distinguished by Dr. Stirton, but the manuscript name, *Alicularia viridis*, which he gave to it was not published. It is in some manner to be regretted that Balfour did not name the plant in his honour, instead of that of the eminent hepaticologist, Dr. Carrington, whose name was less connected with this species.

XXVI. ANASTROPHYLLUM (Spruce) Steph.

Jungermannia Subgen. *Anastrophyllum* Spruce, Journ. Bot. p. 234 (1876). *Anastrophyllum* Steph., Hedwigia 32 p. 140 (1893).

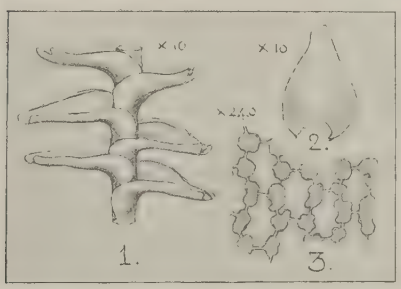
Plants large, reddish-yellow or purple with erect or procumbent stems, and few rhizoids. Branches, if present, proceeding from the postical angle of the leaves. Leaves succubous, *subtransversely*

inserted, the antical half of the line of insertion nearly transverse, the postical half oblique, antically secund, concave, apex nearly always *bifid with unequal segments*, the antical the smaller ; cell-walls strongly incrassate, *trigones nodulose, frequently confluent.* Underleaves commonly absent. Inflorescence dioicous. Bracts rather larger than the leaves, frequently denticulate or laciniate. Perianth terminal, narrowly oblong, cylindrical below, narrowed and plicate above, *the mouth laciniate.* Capsule oval, shortly pedicellate. ♂ bracts terminal or at middle of stem, imbricate, saccate at base ; antheridia 2–4.

Although this genus is probably most nearly related to *Sphenolobus*, as appears from the writings of Stephani and Schiffner, I have followed these authorities in retaining it in its present position. Its most important character is the peculiar insertion of the leaves which causes them to be antically secund. The strongly incrassate cell-walls also occur in nearly all the species.

91. Anastrophyllum Donianum (Hook.) Steph.

Jungermannia Doniana Hook., Brit. Jung. *pl.* 39 (1813).
Pleuroschisma Doniana Dum., Syll. Jung. p. 72 (1831).
Anastrophyllum Donianum Steph., Hedwigia 32 p. 140 (1893).
Bazzania Doniana Cooke, Hand. Brit. Hep. p. 82 (1894).



1. Stem with leaves. 2. Leaf. 3. Cells.

Dioicous. In *large reddish-brown to purple-brown loose tufts.* Stems 3–7 cm long, simple or sparingly branched, with occasionally innovations from below the ♀ inflorescence, *sub-erect*, filiform, flexuous, slightly incurved at the apex, dark brown, *rigid and brittle when dry ;* rhizoids colourless, scarce, to near apex of stem. Leaves *elongate-ovate* or oblong-ovate, shining, of the same size throughout, *antically secund and arcuate, horizontal*, semi-amplexicaul and *almost transversely inserted* with the antical margin decurrent, *conduplicate-concave*, margins incurved, unequally and *very shortly bilobed*, the postical lobe larger and obtuse, the antical lobe obtuse or subacute, sinus narrow, round or subacute ; cells 14–23 μ, elongate at base, often distinctly longitudinally seriate, *trigones very large and nodulose*, pale yellow. Involucral bracts broader than the leaves, erect, concave, embracing the perianth, the lobes triangular, acute

or apiculate, sinuate-dentate, sinus acute. Perianth longly exserted and slightly incurved, cylindrical-oblong, plicate near apex, the mouth slightly contracted, *laciniate-ciliate*. ♂ bracts terminal, in 4–6 pairs, imbricate, saccate at base, the antical margin arcuate; antheridia 2–4, broadly oval, on a pedicel of equal length.

HAB. Rock ledges and grassy places among rocks from 1900–3600 ft. alt.

DISTRIB. Perth and Argyll to Sutherland, very rare. Fr. Aug.

Unlike any other British species; the dark reddish-brown to purple colour of the concave, secund, shortly bilobed leaves make this tall plant easily recognised. The leaves are sometimes almost falcate-secund; the trigones are in great part longitudinally confluent, but towards the margin of the leaves this is frequently less noticeable and the cell-cavity is stellate. Only two or three antheridia in each bract become fully developed; old bracts of the male inflorescence can be seen interruptedly down the stem.

This species is found in Britain only in small tufts or as scattered stems among other species, especially *Anastrepta orcadensis* and *Scapania ornithopodioides*. In Norway the plant is seen up to 20 cm in length and in large patches.

A. Jörgensenii Schiffn., Hedwigia Vol. 49 p. 396 *pl.* XI f. 1–13 (1910), a nearly related species, was discovered by Herr Jörgensen in western Norway in 1902. It differs from *A. Donianum* in being lighter in colour, more slender, leaves much broader in proportion to their length, being about as broad as long and with a much broader apex, the lobes broad, as is frequently also the sinus; the involucral bracts are also different, the cells of the upper part of the perianth less thickened and the cilia of the mouth shorter.

The other European species of this genus, *A. Reichardti* (Gottsche), has a more eastern distribution, but as it has been found in western Norway, it will possibly be found to occur in Britain. It is smaller than *A. Donianum*, the leaves rotund-quadrate, and $\frac{1}{3}$–$\frac{1}{4}$ bilobed. Its variety *nardioides* (Lindb.), sometimes considered as a separate species, has also been found in western Norway. It resembles a large *Sphenolobus minutus*, but has less complicate leaves which are also less deeply bilobed, and with the cell-walls more thickened.

XXVII. GYMNOCOLEA Dum.

Jungermannia Sect. *Gymnocolea* Dum., Syll. Jung. p. 52 (1831).
Gymnocolea Dum., Rec. d'obs. p. 17 (1835); K. Müll., Krypt. Fl. p. 739 (1910).

Dioicous. Plant with the habit of *Lophozia*, dark green to almost black in colour. Stems slightly or not branched. Branches *arising variously*, some from the axil of ovate-lanceolate leaves, some from the axil of bilobed leaves, others intercalary from the postical side of the stem. Leaves *bilobed*, the lobes most commonly obtuse. Underleaves seldom present. Involucral bracts *spreading from the perianth, smaller or at least not larger* than the leaves but otherwise

resembling them. Perianth *clavate-pyriform, smooth* with the mouth *narrow*, dentate, *breaking off when sterile* (in *G. inflata*) *and forming new plants* by rooting in the ground. Antheridia *single.*

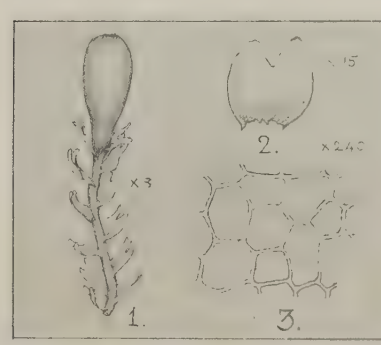
Dumortier founded this genus on the character of the perianth being naked, that is, not being closely surrounded by the bracts but standing as it were free from them, and in *Hep. Eur.* he has a heterogeneous collection of species included in it. The genus is now well defined by several characters, chiefly the various manner of branching, the vegetative increase by means of the perianth and the single antheridium in each bract, as well as by the small patent involucral bracts and the smooth perianth with its narrow mouth.

The three modes of branching in this genus comprise the two terminal forms, where either, (1) the whole of the ventral segment which ordinarily produces the postical lobe of the leaf forms the rudiment of the branch, so that only the dorsal lobe is developed, or, (2) where only part of the ventral segment forms the branch, the remainder forming the ventral lobe; also, (3) intercalary branching, where the branch arises endogenously from the middle of the ventral segment.

{Lobes of leaf rounded, perianths nearly always present; usually on wet moors or heathy places .....*92. inflata*
{Lobes of leaf usually subacute or acute, perianth absent; in intricate patches on rocks and boulders .....*93. acutiloba*

92. Gymnocolea inflata (Huds.) Dum.

Jungermannia inflata Huds., Fl. Angl. p. 511 (1762).
Gymnocolea inflata Dum., Rec. d'obs. p. 17 (1835).
Lophozia inflata Howe, Mem. Torr. Bot. Club p. 110 (1899).



1. Plant with perianth. 2. Leaf. 3. Cells.

Dioicous. In *dark green to brownish-black* tufts, sometimes forming extensive depressed patches, or scattered among Sphagnum. Stems 1–2 cm long, thin and flaccid, procumbent to suberect, simple or sparsely branched, with innovations from below the ♀ inflorescence; *rhizoids scarce*, colourless or brownish. Lower leaves obliquely inserted, horizontal to patent and nearly flat, the upper more transverse and frequently erecto-patent, concave with the lobes incurved, most *commonly distant* or the upper approximate, oblong-cuneate to *broadly ovate or oblong*, the antical margin slightly decurrent, $\frac{1}{3}$ bilobed, *sinus narrow*, obtuse, *lobes ovate, obtuse*, frequently unequal; cells 20–28 μ,

of nearly equal size throughout, 4–5-angled, the walls slightly and equally thickened, trigones being absent or indistinct; cuticle usually smooth. Underleaves commonly absent, when present subulate to lanceolate or rudimentary, scarce. Involucral bracts *similar to the leaves but one or both smaller*, transversely inserted, *widely spreading from the perianth*, concave. Perianth *longly exserted*, frequently appearing as if dorsal on account of innovations, *oblong-obovate or pyriform*, *smooth;* the apex rounded and slightly plicate, shortly 4–5-lobed, the lobes sparingly dentate. Capsule oblong-ovate. Spores 12–15 μ, granular-papillate, brown. Elaters reddish-brown. ♂ plant more slender, bracts terminal, in 4–6 pairs, transversely inserted, broader than long, concave; antheridia *single*, globose-oval, pedicel short.

var. **heterostipa** (Carr. et Spruce) K. Müll., Krypt. Fl. I p. 743 (1910).

Cephalozia heterostipa Carr. et Spruce, Spruce On Ceph. p. 55 (1882); Pears., Hep. Brit. Isles p. 168 *pl.* 64 (1900).
Jungermannia inflata var. *heterostipa* Lindb., Musc. Asiae bor. p. 47 (1889).

Stems simple or branched; *distant and small-leaved postical intercalary branches frequently present*, also lateral branches from the axil of an *undivided*, *ovate-lanceolate leaf*, the apex of stem sometimes bifurcate; rhizoids frequently numerous to apex of stem; lobes of leaf more commonly unequal; underleaves not rarely present.

HAB. Wet moors and heathy places, seldom on wet rocks, ascending to 3600 ft. alt.

DISTRIB. N. to Shetland, common. Var. *heterostipa*, Wales to Perthshire, ascending to 3100 ft. alt., rare.

The dark green to almost black spongy masses, together with the obtuse leaf-lobes and the smooth, pyriform perianth, make this species easily known. Sterile perianths are very common; they are frequently broken off the stem, and have sometimes rhizoids formed at their base, and by this means produce new plants; owing to the innovations they often appear as if dorsal instead of terminal. The ♂ plant is uncommon and is generally in separate tufts. Fruit is rare.

Some mountain forms, especially nearly black plants which are found on rocks at rather high elevations, might be mistaken for a small *Marsupella*; other forms might be taken for one of the *Mars. Sullivantii* group, but the present plant may be known from any species of that genus at all likely to be confused with it by the cell structure and insertion of the leaves. *Cephalozia fluitans*, which greatly resembles it in appearance, may be known by its much larger leaf-cells, the presence of flagella, and by its inflorescence being postical. *Lophozia turbinata* has a slight superficial resemblance to *G. inflata*, but it is pale green, leaves often with acute lobes, larger cells, large involucral bracts, and frequent presence of an antical tooth on both ♂ and ♀ bracts.

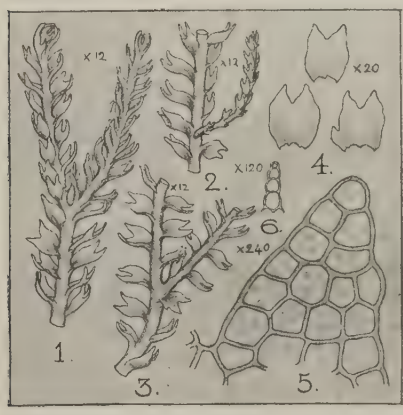
This species varies greatly according to the kind of situation in which it occurs. Nees in *Eur. Leb.* II p. 42 gives several forms, and Schiffner in *Krit.*

Bemerk. in *Lotos* No. 7, 1903, deals exhaustively with the various forms, most of which are represented in the accompanying *Hep. Eur. Exs.* The most common form, which is taken as the typical plant, is *β subaggregata* Nees. This is found in wet heathy or boggy ground; the leaves are approximate to somewhat imbricate, rather concave but without incurved lobes. The f. *nigricans* Nees resembles this, but is black and rather shiny, with broad leaves having incurved lobes. The f. *laxa* Nees grows in ditches, bogs and pools on moors. It is frequently submerged, and has thin, lengthened stems, and soft and distant leaves, which are nearly flat and with the sinus sometimes deeper. The f. *natans* Schiffn. is the extreme aquatic form. It occurs as free swimming, loose tufts in pools, and is the largest form of the species, with large and very distant, flat leaves. The last two forms may be seen in one pool, connected by intermediate forms according to the depth of the water. At the other extreme is the f. *compacta* Nees which is found in rather dry situations. It forms small compact tufts with closely imbricated and usually concave leaves.

The var. *heterostipa*, which is most frequently found on rocks, has been a much discussed plant. Spruce in *On Cephalozia* originally described it as a species of *Cephalozia*. In the notes to the description he states that this species "brings us into actual contact with *Jungermannia* through the section *Gymnocolea* Dum. of the latter." Lindberg first showed that the plant belonged to *Gymnocolea inflata*. Schiffner has gone fully into the question in *Lotos* No. 7 p. 26 (1903), where he points out among other features that the postical branches are not analogous to the postical flagella of *Cephalozia*.

93. Gymnocolea acutiloba (Kaal.) K. Müll.

Jungermannia acutiloba Kaal., Nyt Mag. f. Nat. 40 p. 250 (1902).
Lophozia acutiloba Schiffn., Hedwigia 48 p. 187 (1909).
Gymnocolea acutiloba K. Müll., Krypt. Fl. I p. 745 (1910).



1. Branch from ovate-lanceolate leaf. 2. Postical branch. 3. Branch from bilobed leaf. 4. Leaves. 5. Cells. 6. Underleaf.

Sterile. In *black or blackish-green intricate patches on rocks.* Stems 1–1·5 cm long, procumbent, simple or with a few lateral branches from the axil of an ovate-lanceolate leaf, seldom from the axil of a bilobed leaf, frequently with the apex bifurcate, *intercalary postical branches scarce*; rhizoids rather scarce, extending to apex of stem. Leaves rather *distant*, almost transversely inserted, not decurrent, erecto-patent to *widely spreading* (in the British plant), seldom suberect, *nearly flat* but with the apex of the lobes

usually incurved, narrowed at the base *oval-quadrate* to obovate, $\frac{1}{3}$ to sometimes nearly $\frac{1}{2}$ bilobed, rarely 3-lobed, the sinus *narrow*, obtuse or subacute, unequal, *somewhat divergent*, narrowly ovate to triangular, *subacute to acute*, seldom obtuse, the base of antical margin occasionally with an obtuse tooth; cells 20–28 μ, of nearly equal size throughout, the walls nearly equally thickened, trigones indistinct. Underleaves scarce and usually only present on the innovations, small and subulate, incurved.

HAB. Boulders and rocks.

DISTRIB. Rhinog Fawr, Merionethshire, alt. 2000 ft., 1910 *(D. A. Jones)*.

This plant is very closely related to *G. inflata* var. *heterostipa* and it is doubtful how far they can be considered as permanently distinct. This is illustrated in the case of the Welsh plant which Kaalaas is convinced belongs to *G. acutiloba*, while Schiffner considers it to be the var. *heterostipa* of *G. inflata*. I incline to Kaalaas' view in the matter. The habit of the plant, the more acute leaf-lobes and the comparatively few postical branches are more like the character of *G. acutiloba*.

Schiffner has described a var. *heterostipoides* of *G. acutiloba*, having the leaves more imbricate and more concave and with the lobes most frequently obtuse. These characters approach those of the var. *heterostipa* of *G. inflata*, so much so, that Kaalaas inclines to look upon it as an intermediate form. When these plants have been found in more extended localities, and the degree of variation becomes known, their relative positions can be more satisfactorily established.

XXVIII. LOPHOZIA Dum.

Jungermannia Sect. *Lophozia* Dum., Syll. Jung. p. 53 (1831).
Lophozia Dum., Rec. d'obs. p. 17 (1835).
Jungermannia Dum., Hep. Eur. p. 68 (1874).

Plants small to large. Stem prostrate or ascending, more rarely erect, simple or slightly branched, branches proceeding from the postical angle of the leaves, frequently with innovations from below the ♀ inflorescence. Leaves succubous, obliquely inserted, decurrent, *2-lobed*, or in a few cases *3–5-lobed*; cell-walls thin or thickened, never nodulose. Underleaves present or absent. Bracts nearly always larger than the leaves, generally more lobed and frequently dentate. Perianth terminal, longly exserted, ovate to cylindrical, nearly always *plicate above*, *contracted at the apex*, in a few instances with a tubular beak. Capsule longly pedicellate, the inner layer of

wall with semi-annular thickenings. Elaters bispiral. Androecium terminal or at the middle of the stem, bracts saccate at base, frequently with an additional antical tooth or lobe. Gemmae frequent, usually angular.

Lophozia contains a larger number of our species than any other genus, although it is only a part of what has generally been united under *Jungermannia*. The 'Bidentes' section, comprising nearly all the bilobed species, has been divided by Müller into two subgenera, *Leiocolea* and *Dilophozia*. The former is the *L. Muelleri* group, which is sharply separated from the latter, but of which the species are sometimes difficult to distinguish from each other. Schiffner in *Verh. k. k. Zool. bot. Ges. Wien* p. 381–405, 1904, has done great service in clearing up this group. *Dilophozia* is composed of several groups which give much difficulty, especially the *ventricosa* series and the *alpestris* series. The 'Barbatae' group was separated as a genus by Loeske under the name *Barbilophozia*; it is not at all sharply divided from *Dilophozia* and is more desirably treated as a subgenus by Müller. As with the other subgenera, the student will sometimes find considerable difficulty with several of the species. These difficulties will in a large measure disappear when an intimate knowledge of the character of the typical plant of each species has been gained, as they nearly all vary within definite limits.

1 { Leaves from middle of stem commonly 2-lobed 2
  { Leaves from middle of stem commonly 3–5-lobed 19

2 { Underleaves constantly present 3
  { Underleaves absent or rarely a few present 8

3 { Leaves transversely inserted, complicate, occasionally 3-lobed; underleaves bifid ..... *118. Kunzeana*
  { Leaves obliquely inserted, not complicate, underleaves subulate 4

4 { Upper leaves gemmiferous and deformed ..... *98. heterocolpa*
  { Gemmae absent 5

5 { Paroicous 6
  { Dioicous 7

6 { Stems to 3 cm long; on moist rock ledges ..... *99. Kaurini*
  { Stems 4–7 cm long; in erect swelling tufts in bogs ..... *100. Schultzii* v. *laxa*

7 { Stems to 3 cm long, leaves $\frac{1}{4}$ bilobed, very shortly decurrent; cells 27–33 μ; involucral bracts sometimes dentate ..... *96. Muelleri*
  { Stems to 5 cm long, leaves $\frac{1}{6}$–$\frac{1}{5}$ bilobed, distinctly decurrent; cells 35–42 μ; involucral bracts always entire ..... *97. bantriensis*

8 { Stems to 12 mm long, translucent; cell-walls thin; gemmae absent 9
  { Larger, or if small then with dark, opaque stems and thick cell-walls or with gemmae 10

9 { Cells 30–35 μ, trigones generally present ..... *95. badensis*
  { Cells 35–42 μ, trigones absent ..... *94. turbinata*

10 { Lobes rounded-obtuse ..... *119. obtusa*
   { Lobes acute or pointed 11

11 { Paroicous 12
   { Dioicous 13

12 { Stems less than 1 cm long; cell-walls strongly thickened ..... *107. bicrenata*
   { Stems usually more than 1 cm long; cells-walls thin ..... *108. excisa*

13 { Stem very thick, plant bluish-green, margin of upper leaves spinous-dentate ..... *109. incisa*
   { Stem thin, plant not bluish-green, margin entire 14

14 Lobes of leaf incurved, sinus shallow; brown or green and flaccid; alpine 15
Lobes not incurved, sinus deeper: green or reddish, not flaccid; usually on the low ground 16

15 Leaves broadest above the middle, sinus very shallow, gemmae greenish; in flaccid tufts in wet places ..... *106. Wenzelii*
Leaves broadest below the middle, gemmae reddish; in firm brown patches on moist soil or rocks ..... *105. alpestris*

16 Gemmae reddish-yellow; leaves squarrose with attenuated lobes, cell-walls very thin ..... *101. longidens*
Gemmae absent or greenish; leaves erecto-patent or spreading, lobes not attenuated 17

17 Gemmae absent; plant always on decaying wood ..... *104. guttulata*
Gemmae nearly always present 18

18 Mouth of perianth hardly lobed, dentate, the teeth mostly 1 cell long; leaf-cells usually with small trigones ..... *102. ventricosa*
Mouth of perianth distinctly lobed, dentate-ciliate, the teeth mostly 2–4 cells long; leaf-cells usually with large trigones ..... *103. porphyroleuca*

19 Stems with cylindrical, small-leaved innovations ..... *115. attenuata*
Stems without such innovations 20

20 Underleaves absent, or a few present, small and subulate 21
Underleaves constantly present, bifid 23

21 Stems 1–2 cm long; leaves very concave ..... *114. atlantica*
Larger; leaves flat, or the antical lobe reflexed 22

22 Postical margin of leaf curved, longer than the reflexed antical margin, lobes sharply pointed ..... *110. quinquedentata*
Postical margin not longer than the antical margin; leaves flat, lobes usually obtuse ..... *116. barbata*

23 Cilia absent at base of postical margin of leaf; leaves flat, lobes usually obtuse ..... *116. barbata*
Cilia present; leaves usually crispate, lobes pointed *24*

24 Cells of cilia about as broad as long 25
Cells of cilia much longer than broad 26

25 Leaves 3-lobed to $\frac{1}{3}$, lobes broadly triangular with nearly flat margins; cuticle smooth ..... *113. Floerkii*
Leaves usually 4-lobed to $\frac{1}{2}$, lobes narrowly triangular with recurved margins; cuticle coarsely verrucose ..... *117. quadriloba*

26 Leaves 3–4-lobed, lobes ovate, frequently bristle-pointed; gemmae frequent *112. Hatcheri*
Leaves 4–5-lobed, lobes broadly triangular, usually mucronate: gemmae rare *111. lycopodioides*

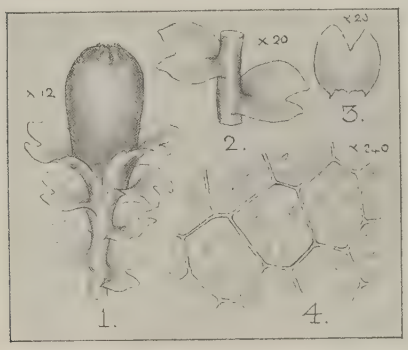
Subgen. **Leiocolea** K. Müll.

Lophozia Sec. *Bidentes* a. Schiffn. in Engl. and Prantl I 3 p. 85 (1893).
Leiocolea K. Müll., Rabh. Krypt. Fl. I p. 711 (1910).

Leaves 2-lobed. Underleaves nearly always present on the sterile stems, subulate or bifid. Perianth cylindrical, smooth, seldom slightly and obtusely plicate at the apex, the mouth suddenly contracted into a short, tubular beak. Species mostly calcicolous.

94. Lophozia turbinata (Raddi) Steph.

Jungermannia turbinata Raddi in Atti Soc. Modena 18 p. 29 (1818).
Jungermannia affiinis Wils. in Sm. Engl. Fl. 5 p. 111 (1833).
Gymnocolea affiinis Dum., Hep. Eur. p. 65 (1874).
Lophozia turbinata Steph., Spec. Hep. II p. 128 (1901).



1. Fertile plant. 2. Portion of stem. 3. Leaf. 4. Cells.

Dioicous. Small. In thin *pale green* or pale yellow-green patches. Stems 4–12 mm long, fragile, translucent, usually conconcolous beneath, generally simple, prostrate or ascending; *rhizoids somewhat scarce*, long, colourless, to near apex of stem. Leaves generally remote, or approximate to imbricate on the upper part of the fertile stem, *very obliquely* inserted, *horizontal*, sometimes ascending near the apex of the stem, *almost flat*, oblong-rotund to ovate, *narrowed at the base and not decurrent*, *cuneate to elliptic on the smaller sterile stems*, $\frac{1}{3}$ bilobed, sinus narrow, lobes rounded-obtuse to acute, somewhat unequal; cells *large*, 35–42 μ, 4–6-angled, translucent, the walls thin, *trigones absent*; cuticle smooth. Underleaves absent. Involucral bracts larger than the leaves, erecto-patent, *loosely surrounding the perianth*, concave, oblong-obovate to subrotund, $\frac{1}{4}$ bilobed, frequently one or both bracts with a third small lobe, lobes rounded-obtuse or sometimes acute; bracteole absent; subinvolucral leaves with occasionally a third small lobe. Perianth longly exserted, *pyriform*, smooth, slightly plicate at the rounded apex, mouth contracted, very shortly rostellate, *shortly ciliolate*. Capsule oval-oblong, reddish-brown. Spores *15–18* μ, verruculose, brown. Elaters reddish-brown. ♂ bracts in 4–8 pairs at middle of stem, suberect, approximate, concave, the antical lobe generally with a tooth, or three-lobed; antheridia oval-globose.

HAB. Moist soil, chiefly calcareous.

DISTRIB. N. to Orkney, uncommon; Ireland. Fr. Mar.–June.

Is sometimes rather difficult to distinguish from *L. badensis*. The following points are useful in distinguishing between them. In *L. turbinata* the leaves,

except generally in the male plant, have a narrow base, even in the broad-leaved forms. This is very marked in the sterile stems, where the leaves become obovate or nearly elliptical. They are also not decurrent at the antical base. The leaf-cells are larger, without thickenings at the angles. The stems are usually concolorous, with comparatively few rhizoids, and the leaves are generally more remote, and lie flat. In *L. badensis* the leaves have a broad base even in the smallest sterile stems, the leaves being there quadrate. The antical base is decurrent, and the cells smaller and slightly thickened at the angles. The stem has copious rhizoids which are fuscous coloured, as is the postical side of the stem.

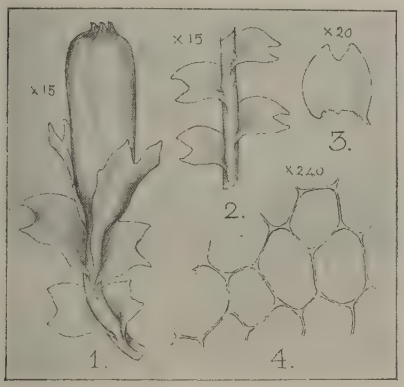
L. turbinata is a western and Mediterreanean species, while *L. badensis* is widely spread throughout Europe.

Beginners frequently mistake *L. turbinata* for a *Cephalozia;* none of our species of that genus have the shape of leaf and sinus of this *Lophozia*, and the mode of branching and inflorescence is different.

95. Lophozia badensis (Gottsche) Schiffn.

Jungermannia badensis Gottsche in. Gott. and Rabh., Hep. Eur. Exs. No 95 (1859).

Lophozia badensis Schiffn., Krit. Bemerk. in Lotos p. 7 reprint (1903).



1. Fertile plant. 2. Stem. 3. Leaf. 4. Cells.

Dioicous. *Small.* In thin *pale green* or yellow-green patches. Stems 4–12 mm long, *translucent*, frequently fuscous beneath, simple or sparingly branched, frequently innovating from below the ♀ inflorescence, prostrate or ascending; rhizoids numerous, long, colourless or brownish, to apex of stem. Leaves usually approximate or imbricate in the upper part of the fertile stem, mostly remote or approximate elsewhere, obliquely inserted, patent to erecto-patent or sometimes horizontal, *concave*, quadrate-ovate to roundish-ovate, *the base broad and shortly decurrent*, *rectangular in the smaller sterile stems*, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, sinus generally acute, lobes acute, or occasionally with a few obtuse; cells *30–35* μ, 4–6-angled, translucent, the walls thin, *trigones small;* cuticle smooth or finely striate-verruculose. *Underleaves absent*, or rarely one or more present and almost rudimentary. Involucral bracts erect, rather closely embracing the perianth, rotund-ovate to rotund-quadrate, concave, $\frac{1}{6}$–$\frac{1}{5}$ bilobed, one or both bracts with occasionally

a third small lobe, sinus acute, lobes acute. Perianth longly exserted, *cylindrical-clavate*, smooth, slightly plicate at the apex, mouth contracted, shortly rostellate, *crenulate* with long cells. Capsule broadly oval, dark reddish-brown. Spores 11–15 μ, verruculose, reddish-brown. Elaters dark reddish-brown. ♂ bracts in several pairs *at middle of stem*, suberect, *approximate*, concave, the antical lobe generally with a tooth, or three-lobed.

var. **obtusiloba** (Bern.) Schiffn., Verh. der k. k. Zool.-bot. Ges. in Wien p. 395 (1904).

Jungermannia turbinata var. *obtusiloba* Bern., Cat. Hép. Suisse p. 65 (1888).

Lobes of leaf obtuse, sometimes acute on the sterile stems; involucral bracts and subinvolucral leaves with a broad and shallow sinus and broad, rounded lobes.

HAB. Moist calcareous soil.

DISTRIB. N. to Caithness, uncommon. Fr. April–June.

Distinguished from small forms of *L. Muelleri* chiefly by its larger leaf-cells, trigones very small, and by the absence of underleaves; occasionally a small underleaf does occur, but this is uncommon, and the numerous underleaves which are found in *L. Muelleri* are never seen. The stem of our present plant is translucent, while that of the other is generally opaque; the different position and form of the ♂ inflorescence is also a good distinctive character.

The var. *obtusiloba* Bernet has generally obtuse lobes, but even if the leaf-lobes are acute, those of the bracts are rounded-obtuse.

Lindberg and Schiffner have shown that *Jung. acuta* Lindenb. is a mixed species; in fact, Schiffner points out that no definite species can be assigned to the name.

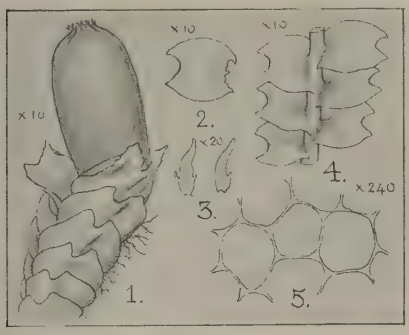
L. badensis is occasionally present in some abundance in sand-dunes, more frequently so than the previous species.

96. Lophozia Muelleri (Nees) Dum.

Jungermannia Muelleri Nees in Lindenb., Syn. Hep. Eur. p. 39 (1829).
Lophozia Muelleri Dum., Rec. d'obs. p. 17 (1835).
Jungermannia bantriensis var. *Muelleri* Lindb., Act. Soc. Sc. Fenn. 10 p. 528 (1875).

Dioicous. In extended green to brownish patches. Stems to 3 cm long, prostrate or ascending, simple or sparingly branched, with innovations from below the ♀ inflorescence; rhizoids numerous, long, brownish or colourless, to apex of stem. Leaves imbricate, on the sterile stems frequently remote, horizontal or antically secund,

quadrate-rotund, the antical margin shortly decurrent, ¼ bilobed, sinus obtuse, usually lunate and frequently gibbose, lobes somewhat unequal, the dorsal lobe generally the smaller, ovate-triangular, *apiculate* or acute, more seldom obtuse; cells 27–33 μ, of nearly the same size throughout, *rounded*-polygonal, the walls thin, trigones large; cuticle verruculose. Underleaves lanceolate or subulate, frequently with a tooth at side. Involucral bracts larger than the leaves, nearly transverse, erecto-patent, undulate, oblong-ovate to subrotund, ⅙–⅕ bilobed, sinus gibbose, obtuse or acute, lobes generally acute, the margin entire or *sometimes slightly dentate*. Perianth longly exserted, nearly cylindrical, smooth, slightly plicate at the obtuse apex, the mouth contracted, rostellate, shortly and unequally ciliolate. Capsule oval. Spores 12–15 μ, verruculose, vinous red. Elaters darker coloured. ♂ bracts in 4–6 pairs, *closely imbricate at apex of stem*, broadly rotund, concave, antical margin with a tooth, or three lobed; antheridia globose.



1. Fertile plant. 2. Leaf. 3. Underleaves. 4. Stem. 5. Cells.

var. **Libertae** (Hüben.) Schiffn., Verh. der k. k. Zool.-bot. Ges. in Wien p. 385 (1904).

Jungermannia Libertae Hüben., Hep. Germ. p. 175 (1834).
Jungermannia Laurentiana De Not., Mem. Acad. Tor. II vol. 18 p. 497 (1859).

Resembling large forms of the type, but with the involucral leaves strongly and rather densely spinous-dentate, and with the subinvolucral leaves also spinous-dentate but less densely.

Hab. Wet rocks and rock ledges, most commonly calcareous, subalpine and alpine, ascending to 3400 ft. alt.

Distrib. Wales to Shetland, uncommon; Ireland. Var. *Libertae*, Perthshire. Fr. June.

As noted before, the underleaves are rudimentary or absent in the two previous species, but in the other members of this subgenus they form an easily

observed character which distinguishes them from the subgenus *Dilolophozia*, where underleaves only exceptionally occur; they are generally subulate, entire or more or less toothed at the sides, or sometimes bifid and somewhat arcuate.

L. Muelleri is the most common of the remaining members of the *Leiocolea* subgenus. The apex of the leaf-lobes is most commonly formed by a two-celled apiculus which is to some extent characteristic of the species as distinct from the others. The ♂ and ♀ plants occur on the same or separate tufts. The sterile perianths vary in shape, being generally more or less clavate; several may be seen interruptedly on a stem. The involucral bracts are sometimes slightly dentate but are quite different from the strongly armed bracts of the var. *Libertae*. Not only are the subinvolucral leaves spinous-dentate in the variety but occasionally this may be seen in one or more ordinary leaves.

The f. *pumila* Nees, Eur. Leb. II p. 11, is a depauperate plant with small imbricate leaves. It is found in Britain and is sometimes confused with *L. badensis*, but may be distinguished from it by the notes given with that species.

97. Lophozia bantriensis (Hook.) Steph.

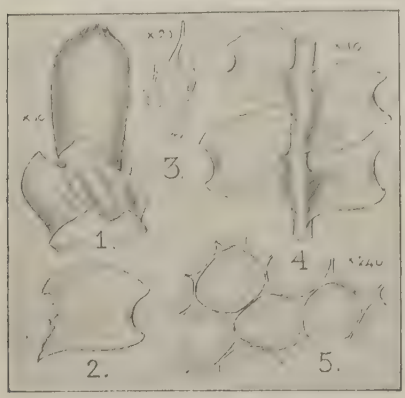
Jungermannia bantriensis Hook., Brit. Jung. no. 41 in adnot. ad *Jung. stipulacea* (1813); Nees, Eur. Leb. II p. 24 (1836).

Jungermannia bidentata var. Hook., Brit. Jung. Synopsis p. 16 et Suppl. *pl.* 3 (1816).

Jungermannia Hornschuchiana Nees, Eur. Leb. II p. 153 (1836).

Jungermannia Muelleri var. *bantryensis* Kaal., De Dist. Hep. in Norv. p. 357 (1893).

Lophozia bantryensis Steph., Spec. Hep. II p. 133 (1901).



1. Perianth and bracts. 2. Leaf. 3. Underleaf. 4. Stem. 5. Cells.

Dioicous. In *large swelling tufts, reddish-brown* in colour, more rarely green. Stems *to 5 cm long*, flexuous, *ascending to suberect*, usually simple, with innovations from below the ♀ inflorescence; *rhizoids rather scarce*, long, brownish or colourless to near apex of stem. Leaves large, *flaccid* and somewhat undulate; slightly imbricate, anticically secund or horizontal, the uppermost suberect, *obliquely subrotund*, the antical margin *decurrent*; $\frac{1}{6}$–$\frac{1}{5}$ bilobed, the sinus broad and shallow, usually gibbose, lobes broadly triangular, *obtuse* or sometimes acute, somewhat unequal; cells *35–42 μ*, larger at the base and smaller at the margin, rounded polygonal, the walls thin, trigones rather small;

cuticle striate-verruculose. Underleaves generally *large*, lanceolate to subulate, frequently more or less laciniate-dentate. Involucral bracts resembling the leaves, but narrower, nearly transverse, erecto-patent, concave, *margin entire*. Perianth longly exserted, nearly cylindrical, smooth, very slightly plicate near the obtuse apex, the mouth contracted, shortly rostellate, shortly and unequally ciliolate. Capsule oval. Spores 13–16 μ, verruculose, vinous red. Elaters darker coloured.

var. **subcompressa** (Limpr.) Schiffn., Krit. Bemerk. in Lotos nr. 8 p. 55 (1901).

Jungermannia subcompressa Limpr., Jahr. Schles. Ges. Vat. Cult. 61 p. 209 (1884).

Jungermannia bantryensis var. *subcompressa* Lindb., Musc. Asiae bor. p. 43 et 45 (1889).

Large, reddish-brown, leaves very obliquely inserted, *strongly anticaly secund and erecto-appressed*, broader than long, sinus broad and obtuse, lobes small, usually obtuse.

Hab. Wet rocky banks and side of streams and in marshes, subalpine and alpine, ascending to 3000 ft. alt.

Distrib. Wales to Caithness, rare; Ireland. Var. *subcompressa*, Ben Lawers.

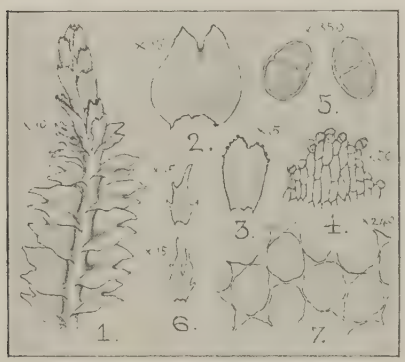
The italicised characters will serve to distinguish typical plants from *L. Muelleri*, but I occasionally find much difficulty in distinguishing between them: the present plant is larger than that species, and forms large swelling tufts, the leaves are usually of a different shape and have a shallower sinus and more frequently obtuse lobes, the antical margin is more decurrent and is frequently inflated, the cells larger, underleaves larger though varying greatly, being frequently subulate and entire, but more generally with one or more laciniate teeth, involucral bracts always entire. The mouth of the perianth is rather more shortly rostellate, but otherwise is the same as that of *L. Muelleri*. After the extrusion of the capsule the apex divides into four lobes, the summit of each having an irregular row of cilia composed of one, seldom two, long cells. *Harpanthus Flotowianus* has sometimes been confused with this plant: the leaf sinus, cell structure and underleaves will serve to distinguish them even without the very different inflorescence. The var. *subcompressa* is a taller and more aquatic plant than the type; the leaves are compressed against each other and against the stem, and are markedly secund.

I cannot see that there is adequate cause for adopting Nees' name of *Jung. Hornschuchiana* for this species, as has been done very generally of late on the Continent. Hooker describes the plant sufficiently in his note on *Jung. stipulacea* in *Brit. Jung.* No. 41, where he gives it the name *Jung. bantriensis* M.S.S. That he afterwards mistakenly thought it might be a variety of *Jung. bidentata*, and figured it with that name in Plate III of the Supplement, does not nullify his more correct original view that it was an undescribed species. The question of Hooker's original specimen has been investigated by Marshall A. Howe in his *Hep. and Anthoc. of California* p. 110. He there mentions that Pearson sent him a specimen labelled "Jung. bantriensis Hook. Bantry. Coll. Miss Hutchins

Nov. 19. 1812 Original" which he found to agree in all essentials with *Jung. Hornschuchiana* Nees in G. and R. Hep. Eur. Exs. No. 128. Pearson's description of the plant in *Hep. Brit. Isles* p. 312 leaves no doubt of his own view of the species. Howe also enquired as to there being any original specimen at Kew, and he was informed by the Director that there is no specimen of the species at Kew marked "Bantry, Miss Hutchins" but a plant was forwarded to him with the label, apparently in Wilson's handwriting, "This is probably the specimen mentioned in Brit. Jung. See note to description of J. stipulacea." This specimen proved to be *Harpanthus Flotowianus*. This mistake was, of course, not Hooker's. The *Harpanthus* is not known to occur in Ireland, and we see that Hooker in the note following his description of *J. bantriensis* in *Brit. Jung.* no. 41, mentions another found in Scotland by Lyell. This is evidently, from his remarks, *Harp. Flotowianus*. Limpricht mentions in *Krpyt. Fl. Schles.* p. 276 that there is a specimen in Herb. v. Flotow labelled "J. bantriensis N. v. E. Ireland. Herb. Hook! d d N. ab. E" which is the gemmiferous form of *J. Muelleri*. This is *J. heterocolpa*, a species which has not otherwise been recorded from Ireland, and is not likely to occur there, as it is of an eastern type of distribution in Britain, and has only been found very rarely in the Highlands of Scotland. There is probably some error in the locality.

98. Lophozia heterocolpa (Thed.) Howe

Jungermannia heterocolpos Thed., Kungl. Sv. Vet. Akad. Handl. p. 52 (1838). *Jungermannia Muelleri* var. *heterocolpos* Nees, G. L. N. Syn. Hep. p. 99 (1844). *Lophozia heterocolpa* Howe, Mem. Torr. Bot. Club 7 p. 108 (1899).



1. Gemmiferous stem. 2. Leaf. 3. Upper leaf. 4. Apical cells of do. 5. Gemmae. 6. Underleaves. 7. Cells of normal leaf.

Dioicous. In green to yellow-green patches or more commonly *loosely tufted among mosses*. Stems to 15 mm long, ascending or suberect, simple or sparingly branched, with innovations from below the ♀ inflorescence; rhizoids numerous, long, brownish, to apex of stem. Leaves imbricate, patent, somewhat antically secund, *rotund-oval*, the antical margin shortly decurrent, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, *sinus rather narrow*, acute or obtuse, gibbose and recurved, lobes unequal, *obtuse* and frequently rotundate, sometimes acute; cells 24–30 μ, rounded-polygonal, opaque, the walls thin, *trigones large;* cuticle verruculose. Underleaves *ovate-lanceolate* with usually 1–3 dentate-ciliate teeth on each side, or bifid with long divergent segments. Involucral bracts

transverse, erecto-patent, rotund-ovate, concave, undulate, sinus narrow, acute, lobes acute or obtuse. Perianth longly exserted, *oblong-ovate*, smooth, apex contracted, the mouth *very shortly* rostellate, irregularly crenate-dentate. *Gemmae brown, oblong, 2-celled, at the apex of deformed, appressed leaves having narrow and thin-walled cells, on attenuated apical shoots.*

HAB. Ledges of calcareous rocks, chiefly subalpine, ascending to ca. 3000 ft. alt.

DISTRIB. Ben Lawers district; very rare.

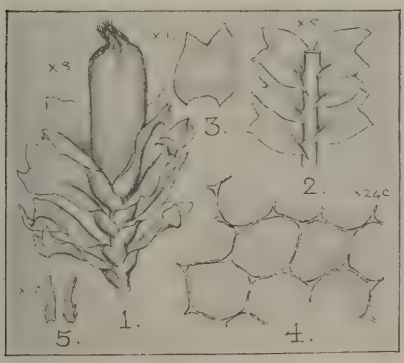
This is the only member of this subgenus in which gemmae occur, and as these are nearly always present, the plant is readily known. When the attenuated gemmiferous shoots are well developed, the underleaves are almost as large as the leaves and of nearly similar shape, the arrangement being thus tristichous. It is distinguished further from *L. Muelleri* by its smaller leaf-cells, leaves of rather different shape, sinus narrower and more gibbose, lobes seldom apiculate but most commonly obtuse and frequently sub-parallel.

99. Lophozia Kaurini (Limpr.) Steph.

Jungermannia Kaurini Limpr., Jahresb. Schles. Ges. Vaterl. Cult. 61 p. 204 (1884).

Jungermannia Muelleri forma *paroica* Bernet, Cat. Hép. Suisse p. 68 *pl.* 3 (1888).

Lophozia Kaurini Steph., Spec. Hep. II. p. 130 (1901).



1. Fertile plant. 2. Stem. 3. Leaf. 4. Cells. 5. Underleaves.

Paroicous. In rather broad and lax *green* to yellow-green tufts, generally accompanied with mosses. Stems to 3 cm long, suberect, usually simple, with innovations from below the ♀ inflorescence; rhizoids numerous, long, brownish or colourless to apex of stem. Leaves undulate, imbricate, horizontal or antically secund, oblong-quadrate, the antical margin shortly decurrent, $\frac{1}{5}$–$\frac{1}{4}$ bilobed, sinus very variable, broad, obtuse, frequently gibbose, lobes somewhat unequal, acute and *frequently sharply pointed*, sometimes obtuse or rounded; cells *34–42* μ, rounded-polygonal, larger and

oval at the base, the walls thin, trigones rather small; cuticle coarsely verruculose. Underleaves subulate to lanceolate, occasionally with one or more teeth at the sides. *Subinvolucral bracts in 4–6 pairs*, larger than the leaves, transversely inserted, imbricate, *erecto-patent*, concave, undulate, saccate at base, the sinus strongly gibbose, rotund-ovate to oblong-ovate, the antical margin *frequently with a small rounded lobe;* antheridia in pairs, oval-globose, shortly pedicellate; involucral bracts similar to the subinvolucral bracts, frequently not saccate at base. Perianth longly exserted, nearly cylindrical, smooth, mouth contracted, *rather longly* rostellate, shortly and unequally ciliolate.

HAB. Among wet calcareous rocks.

DISTRIB. Ousdale, Caithness, ca. 500 ft. alt., 1903 *(D. Lillie)*.

The paroicous inflorescence at once distinguishes this from our other members of the subgenus except *L. Schultzii*; the large, imbricate, subinvolucral bracts can be seen with the lens. The leaves are more variable in shape than in *L. Muelleri*, and the lobes are frequently acutely pointed instead of apiculate as in that species; the cells are also larger. The leaves are often remote on the sterile stems and at the base of the fertile stem in this species as in the others. The antheridia can be readily seen at the apex of short innovations which proceed from beneath the perianth; the bracts on these innovations are seldom gibbose. I have not seen fruit on the British plant, but perianths are common. This species will probably be found on the Grampian range of hills.

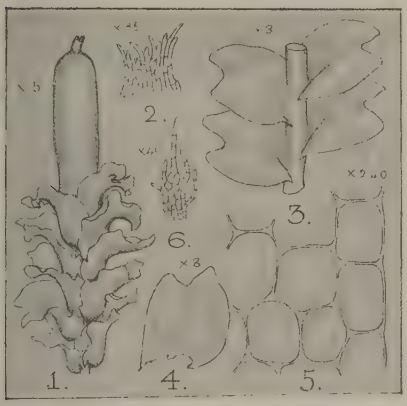
100. Lophozia Schultzii (Nees) Schiffn.

Jungermannia Schultzii Nees, Eur. Leb. II p. 30 (1836).
Jungermannia Rutheana Limpr. Jahr. Schles. Ges. Vat. Cult. 61 p. 207 (1884).
Jungermannia lophocoleoides Lindb., Med. Soc. pro. F. Fl. Fenn. 14 p. 66 (1887).
Lophozia Rutheana M. A. Howe, Bull. New York Bot. Gard. 2 p. 102 (1901); Evans, Ottawa Nat. 17 p. 18 *pl.* 2 (1903).
Lophozia Schultzii Schiffn., Verh. der k. k. Zool. bot. Ges. in Wien p. 387 (1904).

Paroicous. In rather *large and lax, spongy reddish-brown tufts*, or scattered among mosses, *in very wet ground.* Stems 4–7 cm long, and with the leaves *3–4 mm broad*, simple or nearly so, flexuous, *erect* or suberect, rhizoids *short*, numerous, pale yellowish-brown, to near apex of stem. Leaves large, flaccid, imbricate, very obliquely inserted, almost horizontal, *convex*, *triangular-ovate*, asymmetrical, *broader than long*, with the antical margin shortly decurrent, the postical margin rotundate at the base and *with 2–4 teeth*, $\frac{1}{5}$–$\frac{1}{4}$ bilobed, the sinus broad, gibbose, recurved, lobes unequal, broadly triangular,

obtuse or subacute, the margins somewhat undulate; cells 35–45 μ, elongated towards the base, trigones large; cuticle *coarsely striate-verruculose*. Underleaves *large, 3–5-fid, the middle segment longest, the segments lanceolate with filiform apices, the margins ciliate*. Subinvolucral bracts suberect, less obliquely inserted, slightly saccate at base, the base of antical margin with a tooth. Antheridia 1–3, mixed *with linear-lanceolate paraphyses*. Involucral bracts embracing the perianth, somewhat larger, *the base of the antical, as well as the postical, margins frequently with 1–4 teeth or cilia*. Perianth large, longly exserted, subcylindrical, narrowed from above the middle to the apex, compressed, the mouth contracted but *not or very shortly beaked*, shortly ciliolate, the cilia composed of 1–2 lengthened cells. Capsule oblong-oval, dark brown.

var. **laxa** Schiffn. ex Burrell, Journ. Bot. p. 217 (1911).



1. Fertile plant. 2. Mouth of perianth. 3. Stem. 4. Leaf. 5. Cells. 6. Underleaf.

Rather smaller. The leaves on the fertile stems less imbricate, quadrate - rotund, not broader than long, nearly symmetrical, the postical margin less rotundate at base and without teeth or cilia, lobes more frequently obtuse; leaves on the smaller sterile stems more distant, oblong-quadrate, with generally obtuse lobes and with the antical margin less decurrent; cells larger, 40 – 50 μ. Underleaves small, lanceolate or subulate, occasionally bifid and filiform at apex, slightly ciliate to entire. Involucral bracts without cilia at base. Perianth longly beaked. Spores 12–15 μ.

Hab. In bogs and marshes.

Distrib. Var. *laxa*, Flordon, Norfolk *(W. H. Burrell*, 1909).

Typical *L. Schultzii* has not yet been found in Britain, though it probably occurs rarely on some of our hills. The paroicous inflorescence will separate it

from the other species of the subgenus *Leiocolea* except *L. Kaurini*, and, when sterile, the characteristic underleaves. The latter species has a different habit and habitat and is smaller, pale-coloured, rhizoids longer, leaves with a narrower base and without teeth or cilia at the postical base, lobes frequently acutely pointed, cells rather smaller, trigones smaller, underleaves small, involucral bracts without teeth at the postical base, perianth beaked. It will be seen that some of these characters are to be found in the var. *laxa* of *L. Schultzii*. This latter plant is anomalous, and it is not altogether certain whether it can be combined with *L. Schultzii* or not. It agrees with this species in habit and in its occurring in bogs, in colour though rather of a more greenish tinge, in the large leaf-cells, and in the general appearance of the plant to some extent, but otherwise it differs greatly, and I have not found the characteristic paraphyses of *L. Schultzii* in the subinvolucral bracts. It appears to me to be closely related to *L. Kaurini*. though apparently less so than to *L. Schultzii*.

Subgen. Dilophozia K. Müll.

Lophozia Sect. *Bidentes* b. Schiffn. in Engl. and Prantl I 3 p. 85 (1893).
Dilophozia K. Müll., Rabh. Krypt. Fl. I p. 659 (1910).

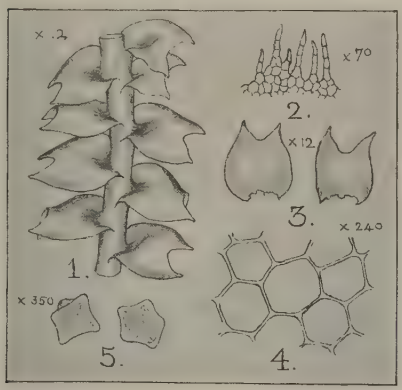
Leaves 2-lobed, rarely 3-lobed, the base of postical margin without cilia, the lobes never bristle-pointed. Underleaves absent on the sterile stems. Upper part of perianth deeply plicate, the apex conical.

101. Lophozia longidens (Lindb.) Macoun

Jungermannia porphyroleuca γ attenuata Nees, Eur. Leb. II p. 80 (1836).
Jungermannia longidens Lindb., Musc. Scand. p. 7 (1879).
Lophozia longidens Macoun, Cat. Canad. Pl. 7 p. 18 (1902).

Dioicous. In small compact tufts, or loosely tufted among mosses, *dark green*, sometimes tinged with brown above. Stems 1–3 cm long, concolorous or pale brown underneath, ascending to suberect, usually simple, sometimes innovating from below the ♀

inflorescence; rhizoids long, colourless, scattered to near apex of stem. Leaves patent, appearing as if somewhat distant, very slightly oblique, half embracing the stem, channelled and concave in the lower half, commonly flat or convex above and *squarrose*, ovate-quadrate to *ovate-rectangular*, shortly decurrent, $\frac{1}{5}$–$\frac{1}{3}$ bilobed, a few occasionally 3-lobed, sinus obtuse, generally lunate, not gibbose, *lobes narrowly triangular and acute*, *straight*, narrowly divergent; cells 24–30 μ, walls thin, *trigones minute;* cuticle smooth. Underleaves absent. Involucral bracts of the same size or slightly larger than the leaves, erecto-patent, concave, irregularly 2–5-lobed, the margin generally with some short teeth, lobes narrow and acute; bracteole variable, usually more or less ovate and dentate. Perianth longly exserted, obovate-clavate, plicate near the apex, the mouth with *several small lobes*, dentate-ciliate and ciliate, the *teeth 1–3, occasionally up to 6, cells long.* Capsule oval-oblong, yellow-brown. Spores 10–13 μ, verruculose, yellow-brown. Elaters reddish-brown. ♂ plant more branched and *densely leaved*, the leaves *erecto-patent*, bracts terminal, in 6–8 pairs, imbricate, transverse, broad and saccate at base; antheridia generally 2, oval-globose, on a pedicel of half its length. *Gemmae reddish- or yellowish-brown*, clustered at the apex of lobes of the upper leaves, mostly 2-celled, many-angled.



1. Stem. 2. Mouth of perianth.
3. Leaves. 4. Cells. 5. Gemmae.

Hab. Subalpine banks, rock ledges and on decaying wood, ascending to 2200 ft. alt. in Perthshire.

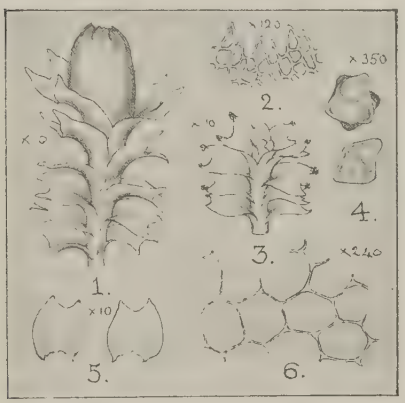
Distrib. Argyll to Aberdeen, rare.

The dark green squarrose leaves with their thin attenuated lobes and thin cell-walls, and the reddish gemmae, make this plant in general to be known without difficulty. The leaves are very chlorophyllose when fresh, and are more frequently 3-lobed than in *L. ventricosa;* they are nearly transversely inserted, the upper ones being sometimes erecto-patent; the lobes are often obtuse through being deformed by gemmae, and the sinus of the upper leaves is frequently acute. The mouth of the perianth is ciliate. The gemmae form small

reddish masses at the apex of the upper leaf-lobes and are a conspicuous character in the British specimens which I have seen. The ♂ plant with its dense and erecto-patent leaves has a different appearance from the ♀ plant.

102. Lophozia ventricosa (Dicks.) Dum.

Jungermannia ventricosa Dicks., Pl. Crypt. Fasc. 2 p. 14 (1790).
Lophozia ventricosa Dum., Rec. d'obs. p. 17 (1835).



1. Fertile plant. 2. Mouth of perianth. 3. Gemmiferous stem. 4. Gemmae. 5. Leaves. 6. Cells.

Dioicous. In *bright green to yellowish-green*, seldom brownish patches, or loosely tufted among mosses, generally on an inorganic substratum. Stems 1–3 cm long, green above, usually brown or *violet underneath*, prostrate or ascending, simple or sparingly branched, frequently with innovations from below the ♀ inflorescence; rhizoids numerous, long, colourless, to apex of stem. Leaves imbricate, slightly oblique, half embracing the stem, generally flat but not seldom obtusely complicate, horizontal, sometimes erecto-patent above, quadrate-ovate to quadrate, shortly decurrent, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, sinus rounded, obtuse, lobes acute; cells 24–30 μ, of nearly the same size throughout, rounded-polygonal, walls thin, *trigones small*; cuticle usually smooth. Underleaves absent. Involucral bracts larger than the leaves, erecto-patent, concave, divided irregularly to about $\frac{1}{3}$ into 2–5, most commonly 3, lobes, the sinus usually plicate, lobes unequal, acute; bracteole variable, bifid or entire, connate with one or both of the bracts. Perianth longly exserted, oblong-oval, obtusely plicate at the apex, mouth *hardly lobed*, dentate, the teeth somewhat distant, mostly *1 cell long*. Capsule oblong-oval, dark reddish-brown, the valves reddish-brown. Spores 10–14 μ, cinnamon-brown, minutely verruculose; elaters bispiral, 85–125 μ long by 7–9 μ broad, reddish-brown. ♂ bracts terminal, in 5–8 pairs, imbricate, transversely inserted, erecto-patent, broadly oval, concave, saccate at base; antheridia

1–2, oval on a pedicel of about half its length. *Gemmae always present, yellow-green*, at the apex of the leaf-lobes, mostly 2-celled, irregularly three- to many-angled.

HAB. On soil and among rocks, tree stems, etc., ascending to the summit of the hills.

DISTRIB. N. to Shetland, very common; Ireland. Fr. April–July.

One of the commonest species and readily recognised when typical. *L. excisa* is paroicous and inflorescence is mostly always present in that plant; it has also a more delicate structure, and the mature gemmae are reddish, while they are greenish in the present plant and are seldom absent. It has always to be remembered that species with reddish gemmae have them frequently colourless when in shade as the pigment is not developed, also when they are immature.

A few leaves are occasionally 3-lobed, especially near the ♀ inflorescence. Sometimes an underleaf occurs at the forking of the stem, but rarely elsewhere except in the inflorescence. The involucral bracts are most commonly 2–3-lobed, frequently one being 2-lobed, and the others 3–4-lobed. ♂ bracts are frequently seen at the middle of the stem, but these are usually empty; those which still contain antheridia are terminal and usually appear as if in 3–4 pairs. The plant has occasionally a reddish tinge.

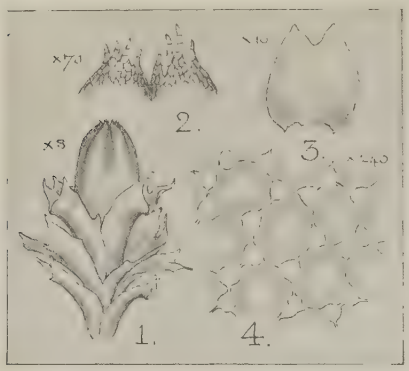
Our members of the *L. ventricosa* group are *L. longidens*, *L. porphyroleuca*, *L. guttulata* and the present plant. Of these *L. longidens* does not appear to have intermediate forms with *L. ventricosa*, but it is otherwise with *L. porphyroleuca*. The latter is treated variously as a variety of *L. ventricosa* or as a separate species. *L. guttulata* is very closely allied to *L. porphyroleuca* and is probably connected with it through intermediate forms. Notes on the various characters are given with these plants. Another European plant of this group, not yet found in Britain though probably occurring on some of our mountains, is *L. longiflora* Nees, *Eur. Leb.* II p. 95. It grows in moist or wet ground among mosses and decaying plants, and it is twice as large as *L. ventricosa*, and thrice as large as *L. porphyroleuca* to which it is most closely allied; stems reddish-black, leaves crowded, frequently reddish at the base, almost transversely inserted, broad with the sinus broad and the lobes commonly obtuse or subacute, the perianth strikingly large and mostly carmine-red except at the apex; the mouth of the perianth resembles that of *L. ventricosa*. It is represented in Schiffner's *Hep. Eur. Ex.* nos. 138 and 139, and particulars are given in the accompanying *Krit. Bemerk.* in *Lotos* No. 7, pp 48–49, 1903. It is figured by Müller in *Krypt. Fl.* and by Miss A. Lorenz in *The Bryologist* p. 43, 1910.

Our alpine forms of *L. ventricosa* and *L. porphyroleuca* are frequently confusing and are mentioned under *L. alpestris* and *L. Wenzelii*. Schiffner gives a var. *uliginosa* of *L. ventricosa* in *Lotos* No. 4. p. 28, 1905. This may be expected to occur in our alpine bogs. It is a large plant with dark reddish stems, pale coloured, broad leaves which are complicate and with pointed lobes, trigones small, involucral bracts crispate, perianth not reddish.

103. Lophozia porphyroleuca (Nees) Schiffn.

Jungermannia porphyroleuca Nees, Eur. Leb. II p. 78 (1836).
Jungermannia ventricosa var. *porphyroleuca* Husnot, Hep. Gall. p. 36 (1875); Limpr. Krypt. Fl. Schles. p. 280 (1876).
Lophozia porphyroleuca Schiffn., Krit. Bemerk. in Lotos No. 7 p. 61 (1903).

Lophozia ventricosa var. *porphyroleuca* K. Müll., Krypt. Fl. I p. 666 (1910).



1. Fertile plant. 2. Mouth of perianth. 3. Leaf. 4. Cells.

Dioicous. Resembling *L. ventricosa*, but differing when typical, in colour, shape of leaf, structure of leaf-cells, mouth of perianth and in habitat. It forms *whitish*-green or pale green compact patches, commonly *tinged with red* or wholly reddish-brown, generally on *an organic substratum*. Stems to 1·5 cm long, rigid, flexuous, *rubescent* or only underneath violet or reddish-brown, prostrate with ascending apex, more or less branched, frequently with innovations from below the ♀ inflorescence; rhizoids numerous, long, colourless, to apex of stem. Leaves frequently *rubescent at base*, closely imbricate, *quadrate-oval*, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, sinus obtuse, lobes subobtuse or acute; cells 24–30 μ, *with large trigones*, the lumen being frequently stellate; cuticle smooth. Involucral bracts and bracteole variable, as in *L. ventricosa*. Perianth *rubescent in the lower half*, the mouth with *several acute lobes* which are closely and unequally dentate-ciliate, the teeth being in large part *2 cells long*, *a few being 3–4 cells long*. Capsule oval, reddish-brown, the valves yellow-brown. Spores 10–14 μ, yellowish-brown, verruculose. Gemmae as in *L. ventricosa*.

HAB. Decaying wood and on peat, subalpine and alpine.

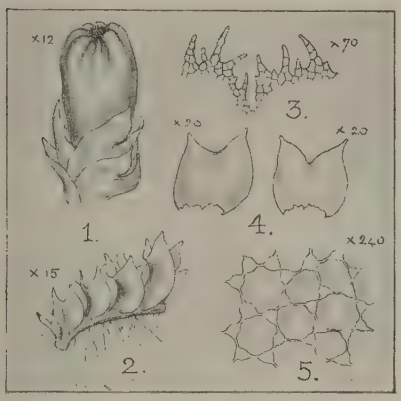
DISTRIB. Wales to Orkney, uncommon; Ireland. Fr. April–July.

The position of this plant has been variously regarded by authors. It had become generally to be considered as a variety or even a synomym of *L. ventricosa* until Schiffner drew attention to the character of the mouth of the perianth. The perianth is very frequently absent and in this case, except in typical plants, the totality of the characters of each have to be used, as none of the characters of stem or leaf are constant. *L. porphyroleuca* is a pale green to whitish plant with dark purple or reddish stems and leaf base, and with frequently a reddish tinge on other parts, this being rare in *L. ventricosa*; the leaves are quadrate-oval and the trigones large, the characters drawn from the leaf being the principal ones, except that drawn from the mouth of the perianth, also the habitat on decaying wood. It is, however, not confined to this habitat, and is frequently found on peaty soil, especially on the western side of the country and in subalpine regions. On the other hand, *L. ventricosa* is sometimes found on decaying wood, and its cell structure is subject to much variation.

The uppermost leaf lobes are frequently reddish, and this must not be mistaken for reddish gemmae.

104. Lophozia guttulata (Lindb. et Arn.) Evans

Jungermannia guttulata Lindb. et Arnell, Musc. Asiae Bor. p. 51 (1889).
Lophozia guttulata Evans, Proc. Wash. Acad. 2 p. 302 (1900).



1. Fertile plant. 2. Stem. 3. Mouth of perianth. 4. Leaves. 5. Cells.

Dioicous. In depressed *green to brownish* patches *on decaying wood*. Stems to *1 cm* long, flexuous, pale reddish-brown to nearly black, prostrate with ascending apex, sparingly branched; rhizoids numerous, long, colourless to apex of stem. Leaves somewhat distant below, imbricate above, slightly oblique, half embracing the stem, patent, the apex frequently squarrose, *subquadrate*, shortly decurrent, $\frac{1}{3}$–$\frac{1}{2}$ *bilobed*, sinus acute or obtuse and *frequently gibbose*, lobes slightly divergent, *acute*; cells 21–28 μ, rounded-polygonal, opaque, *trigones very large*, sometimes confluent, *the lumen being generally stellate*. Underleaves absent. Involucral bracts larger than the leaves, erecto-patent, very variable, irregularly 2–5-lobed, sinus gibbose, lobes acute; bracteole variable, entire or bifid, connate with one or both bracts. Perianth frequently *reddish-purple at the apex*, longly exserted, nearly cylindrical or obovate-clavate, plicate at the apex, the mouth shortly lobed, dentate-ciliate, *the cilia mostly 2–4 cells long*. Capsule oblong-oval, reddish-brown. Spores 8–10 μ, verruculose, reddish-brown; elaters darker coloured. ♂ bracts terminal, in 6–8 pairs, imbricate, transverse, erecto-patent, rotundate-ovate, greatly concave, saccate at base, sinus rather narrow, obtuse, lobes acute; antheridia generally 2, oval-globose, on a pedicel of about half its length. *Gemmae almost always absent.*

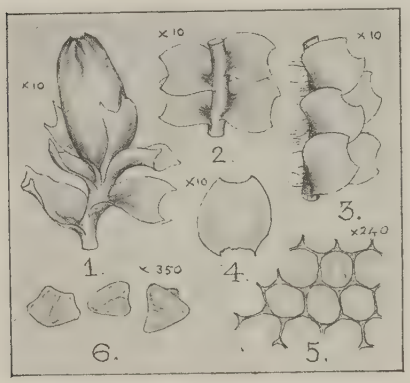
Hab. On decaying wood, subalpine.

Distrib. Aberdeen, 1884 *(G. Stabler)*.

Very closely allied to *L. porphyroleuca* and perhaps doubtfully distinct from it. The present plant is rather smaller, leaves more quadrate and not narrowed towards the apex, leaf-lobes more acute, the sinus rather deeper, gibbose, and gemmae absent. This absence of gemmae is not invariable, though apparently they rarely occur. The mouth of the perianth has shorter and more obtuse lobes and the cilia are longer and finer than in the other. The capsule is yellowish-brown, but the separated valves are reddish-brown. This plant appears to be confined to decaying wood.

105. Lophozia alpestris (Schleich.) Evans

Jungermannia alpestris Schleich., Hist. Musc. Hep. Prod. p. 80 (1815).
Jungermannia curvula et *J. sicca* Nees, Eur. Leb. II p.p. 117, 118 (1836).
Lophozia alpestris Evans, Rhodora p. 181 (1901).



1. Fertile plant. 2, 3. Stem. 4. Leaf. 5. Cells. 6. Gemmae.

Dioicous. In small compact tufts or more frequently as scattered stems among mosses, usually *brown* in colour. Stems to 2·5 cm long, rigid, flexuous, brown to nearly black, more rarely green, darker and frequently *vinous-red* underneath, ascending, sparingly branched; rhizoids long, colourless or vinous red at base, numerous to apex of stem. Leaves *rigid*, imbricate, horizontal, or above erecto-patent, *concave to canaliculate-concave*, quadrate-*rotund*, $\frac{1}{10}$–$\frac{1}{7}$ bilobed, sinus broad and lunate but *variable* and in *some leaves more deeply lobed* and acute, lobes generally acute and more or less incurved; cells *19–24* μ, larger at the base, *rotund to oblong-rotund*, walls usually brown, somewhat thickened, trigones rather large; cuticle smooth. Underleaves absent, or occasionally a few present on the sterile stems. Involucral bracts larger than the leaves, concave, *appressed to the perianth*, oblong-*rotund* or oval-rotund, emarginate or shortly 2-lobed, or occasionally shortly 3-lobed, sinus obtuse, lobes subacute or obtuse; bracteole rotund-ovate or narrowly ovate, usually shortly bilobed, connate with one or both of the bracts. Perianth $\frac{2}{3}$ exserted, oblong-cylindrical, obtusely plicate near the apex, the mouth denticulate. Capsule broadly oval, reddish-brown. Spores 12–14 μ, verrucose, bright reddish-brown. Elaters the same colour. ♂ bracts in 3–8 pairs, imbricate, erecto-patent, concave, saccate at base; antheridia 2–3, globose. Gemmae *reddish*-brown, at the apex of the leaf lobes, 1–2-celled, three- to many-angled.

var. **gelida** (Tayl.) Macv., Ann. Scot. Nat. Hist. p. 49 (1904).

Jungermannia gelida Tayl., Journ. Bot. p. 277 (1845); Pears., Hep. Brit. Isles p. 334 *pl.* 143 (1901).

Jungermannia alpestris var. *gelida* Cooke, Handb. Brit. Hep. p. 186 (1894). *Lophozia gelida* Steph., Spec. Hep. II p. 136 (1901).

Small. Sterile. Stems 4–10 mm long, flexuose or *arcuate*, dark brown, creeping over *Gymnomitrium obtusum*; rhizoids rather numerous to apex of stem. Leaves *erecto-patent*, *antically secund*, concave, rotund to quadrate-rotund, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, sinus broad and lunate, seldom angled at the base, lobes broad, subacute or obtuse; cells *comparatively large*, 18–26 μ, the walls rather more thickened than in the type.

var. **litoralis** (Arnell) Schiffn., Krit. Bemerk. in Lotos Vol. 59 p. 17 (1911).

Jungermannia alpestris var. *litoralis* Arnell in Hep. Galliae Exs. no. 207 (1901).

Soft and flaccid; *pale yellowish-green* with the apex of the leaves sometimes brown. Leaves *broad*, the lobes usually obtuse; *cell-walls thin*, *trigones minute*. Gemmae *colourless* or with a few pale reddish, in quantity at the apex of the upper leaf-lobes.

HAB. Moist soil and among mosses, chiefly alpine, ascending to the summit of the hills.

DISTRIB. Wales to Shetland, uncommon; Ireland. Var. *gelida* rare; var. *litoralis* Wales *(D. A. Jones)*.

The Scandinavian botanists remark on the difficulty of separating this plant from some forms of *L. ventricosa*, and Arnell and Jensen note that there are several intermediate forms between the two species. The plant of lower ground is more like *L. ventricosa* while the alpine plant is more like *L. porphyroleuca*. Low ground forms of *L. alpestris* are rare with us and are almost confined to near the foot of the hills in the east and north-eastern districts of Scotland; they are usually more green in colour than the alpine forms. The most important characters of the present species as distinct from the other two lie in its smaller leaf-cells, the rounder leaves and the variable sinus: the cells are also more rotund and the walls generally yellowish or brown instead of being colourless or pale green. When gemmae are well developed their reddish colour is a good character; also the vinous-red colour, instead of violet, of the postical side of the stem, although the whole plant inclines to brown instead of red as in the other, the conduplicate-concave leaves, and the usually only bilobed bracts which are also more rotund. All these characters are subject to a good deal of variation and, as Arnell remarks, they must be taken as a whole.

A few underleaves are occasionally present on sterile stems. Perianths are rare in Britain and fruit has not been seen. Our plant rather seldom occurs in tufts by itself, but is generally found as scattered stems among mosses.

The description of var. *gelida* is taken from the original specimen. I have seen several similar plants among *Gymnomitrium* on rather dry ground near the summit of some of our higher hills. The plant is larger when on moist ground and becomes indistinguishable from the smaller forms of *L. alpestris*.

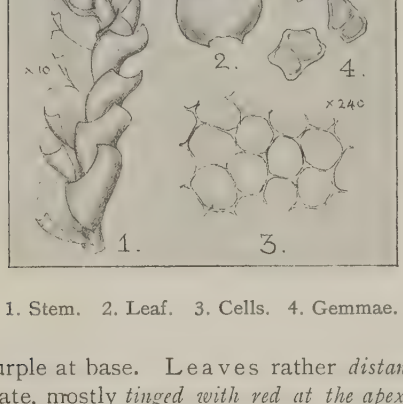
The var. *litoralis*, when well marked, has very soft leaves which are easily

destroyed. The Welsh plant, which was named by Schiffner, differs considerably from the original specimen in being firmer, leaves occasionally 3-lobed and underleaves rather frequently present.

A closely related species of the *L. alpestris* group is *L. confertifolia* Schiffn., Oest. Bot. Zeit. p. 47, 1905. It is dull green, or more or less brownish in the older parts, and with a characteristic appearance on account of its nearly transversely inserted, crowded leaves being strongly antically secund and complicate-concave, with the antical lobes strongly incurved when dry, and somewhat resembling the steps of a ladder; the leaves are widely spreading, broadly elliptical, about ⅓ bilobed, the sinus lunate and with obtuse or subacute lobes; the cells are larger than in *L. alpestris* and have distinct trigones. This plant should be looked for on our hills.

106. Lophozia Wenzelii (Nees) Steph.

Jungermannia Wenzelii Nees, Eur. Leb. II p. 58 (1836).
Lophozia Wenzelii Steph., Spec. Hep. II p. 135 (1901).



1. Stem. 2. Leaf. 3. Cells. 4. Gemmae.

Dioicous. *In erect spongy soft yellow-green to yellow-brown tufts in wet ground.* Stems to 3·5 cm long, soft, pale green above and *reddish-purple* underneath except at the apex of the stem, the older parts altogether reddish-purple, usually simple, *erect*, somewhat flexuous; rhizoids *short, rather sparse*, almost absent towards the apex of the stem, colourless but generally reddish-purple at base. Leaves rather *distant* or less commonly approximate, mostly *tinged with red at the apex, flaccid, erecto-patent, antically secund, concave*, oblique and shortly decurrent, broad, *obovate-oval*, broadest slightly above the middle, sinus *broad and shallow* being occasionally hardly apparent, lobes short, ovate-triangular, obtuse or subacute, more rarely apiculate, generally *incurved*; cells *21–28 μ*, rounded-hexagonal, *opaque*, walls generally yellow, slightly thickened, *trigones small*, distinct; cuticle smooth. Underleaves absent. Involucral bracts erecto-patent, concave, to ¼ bilobed, the lobes more obtuse and more incurved than the leaves; bracteole small, ovate, obtuse to somewhat acute, generally connate with one bract. Perianth longly exserted, cylindrical to oblong-cylindrical, plicate at the apex, mouth shortly lobed, denticulate. Capsule elliptic-oval, brown. Spores 10 *μ*, muriculate, dark brown, ♂ bracts in 5–7 pairs, imbricate, erecto-patent, saccate at base, lobes larger and more

incurved; antheridia 1–2, globose, pedicel short. *Gemmae pale green*, at the apex of the leaf-lobes, 1–2-celled, four- to many-angled.

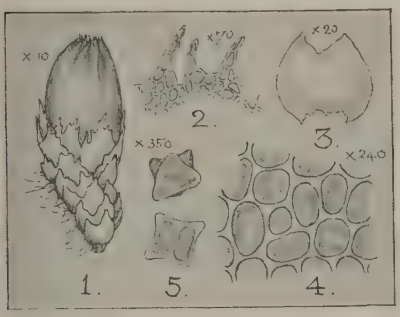
HAB. Wet ground in the higher alpine region.

DISTRIB. West Inverness, Aberdeen; very rare.

This rare species does not appear to be always separable from *L. alpestris*, but the italicised characters will distinguish it in most cases. The leaves are broader and with the apex of the lobes shortly incurved; they are broadest above the middle, while in the latter they are broadest below; the leaf-cells are larger and opaque, with thinner walls and smaller trigones, the postical side of the stem is darker red and the gemmae are pale green; the plant is also stated to have smaller spores and thinner elaters. Besides these characters *L. Wenzelii* grows in wet ground and has a different habit. It is more flaccid than *L. ventricosa*, leaves more distant, of different shape, sinus very shallow, lobes small, incurved and generally tinged with red, and the postical side of stem dark red.

107. Lophozia bicrenata (Schmid.) Dum.

Jungermannia bicrenata Schmid., Icon. et Anal. ed. II 3 p. 247 (1797).
Jungermannia bicrenata Lindenb., Limpr., Krypt. Fl. Schles. p. 281 (1876).
Lophozia bicrenata Dum., Rec. d'obs. p. 17 (1835).



1. Fertile plant. 2. Mouth of perianth. 3. Leaf. 4. Cells. 5. Gemmae.

Paroicous. *Small.* In thin patches to almost gregarious, *reddish-yellow* to *reddish-brown*, in shade yellow-green. Stems to 6 mm long, simple, sometimes innovating from below the ♀ inflorescence, prostrate with ascending apex; rhizoids numerous, colourless or fuscous, to apex of stem. Leaves *very closely imbricated, suberect*, antically secund, concave, rotund-ovate to rotund-quadrate, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, sinus almost right-angled, obtuse or subacute, lobes short, acute; cells 23–28 μ, roundish-oblong to roundish-quadrate, 4–8-angled, *guttulate*, the *walls being strongly thickened* and more so at the angles. Cuticle granulate. Underleaves absent. Subinvolucral bracts resembling the leaves but rather larger, transversely inserted, the antical margin with a tooth, or occasionally 3-lobed, margin of lobes entire or dentate; antheridia generally single, oval-rotund, the pedicel of nearly equal length. Involucral bracts embracing the perianth, distinctly larger than the leaves, irregularly 2–4-lobed, *spinous-dentate or dentate;* bracteole broadly subulate. Perianth inflated, ovate to

oblong-ovate, plicate above, mouth hyaline, irregularly *spinous-ciliate* and dentate, the cilia 2–4 cells long. Capsule nearly globose, reddish-brown. Spores 12–15 μ, granulate, reddish-brown. Elaters reddish-brown. Gemmae in *reddish-yellow* clusters at the apex of the upper leaf-lobes, 2-celled, stellate or irregularly and obtusely angled.

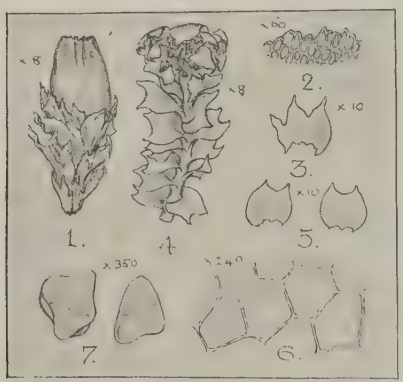
Hab. Dry soil on banks and turf walls.

Distrib. N. to Shetland, frequent in the lower subalpine districts; Ireland. Fr. May–July.

The guttulate cell structure of the leaf will alone distinguish this species; the perianth has also the same thickened cell-walls. The reddish-yellow colour, minute size, the usually present perianths which are deeply plicate in their most common immature state, and the thin patches, make this plant easily known in the field except from the f. *Limprichtii* of *L. excisa*. The stem adheres closely to the substratum, the bracts and perianth alone being erect. It is aromatic when fresh and is one of the smallest species of the genus. One involucral bract is frequently shortly 4-lobed, the other 2-lobed; they are more spinous-dentate than in *L. excisa*, and the mouth of the perianth is spinous-ciliate instead of being crenulate as in the other. The greatly thickened cell-walls must not, of course, be expected in young plants, or when much shaded.

108. Lophozia excisa (Dicks.) Dum.

Jungermannia excisa Dicks., Pl. Crypt. Fasc. 3 p. 11 (1793).
Jungermannia excisa β *crispata* Hook., Brit. Jung. *pl.* 19 *fig* 11 (1812).
Jungermannia capitata Hook., Brit. Jung. *pl.* 80 (1816).
Jungermannia intermedia Lindenb., Syn. Hep. p. 83 (1829).
Lophozia excisa Dum., Rec. d'obs. p. 17 (1835).



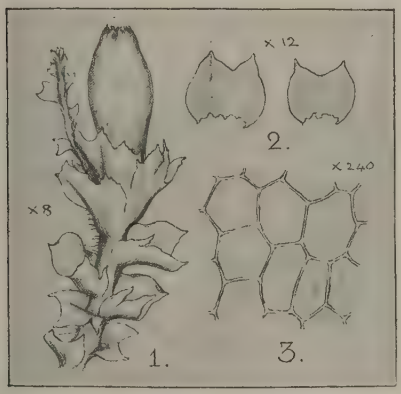
1. Fertile plant. 2. Mouth of perianth. 3. Male bract. 4. Barren stem. 5. Leaves. 6. Cells. 7. Gemmae.

Paroicous. In small tufts, pale green or tinged with red in exposed ground. Stems to 10 mm long, usually simple, pale green, or underneath brownish, prostrate or ascending; rhizoids numerous, long, colourless to apex of stem. Lower leaves approximate or distant and horizontal, upper leaves larger, *erecto-patent and more closely imbricate*, more or less *undulate*, slightly obliquely inserted, the antical margin very shortly decurrent, ovate-quadrate, $\frac{1}{3}$ bilobed, sinus generally lunate,

sometimes right-angled, lobes acute or more rarely obtuse; cells 28–36 μ, irregularly polygonal, *thin-walled throughout or with minute trigones*; cuticle smooth. Underleaves absent. Subinvolucral bracts larger than the leaves, transverse, imbricate, erecto-patent, conduplicate-concave, *undulate or crispate*, broad, irregularly and shortly 2–3-lobed, the antical margin with an additional tooth; antheridia 1–2, oval-globose. Involucral bracts *crispate*, *3–5-lobed*, the margin generally more or less dentate; bracteole oblong-ovate, entire or bifid, connate with one or both bracts. Perianth oblong-ovate to nearly cylindrical, plicate above, mouth *crenulate*. Capsule oval-oblong, reddish-brown. Spores 14–17 μ, verrucose, brown. Elaters reddish-brown. Gemmae *purple*, at the apex of the leaf-lobes, 3–5-angled, a few sometimes pyramidal.

Forma **cylindracea** (Dum.) K. Müll., Krypt. Fl. I p. 696 (1910).

Lophozia cylindracea Dum., Rev. Jung. p. 17 (1835).
Jungermannia socia Nees, Eur. Leb. II p. 72 (1836).
Jungermannia excisa var. *socia* Massal., Spec. ital. gen. Jung. p. 19 (1895).



F. cylindracea. 1. Fertile plant. 2. Leaves. 3. Cells.

In scattered stems among mosses, green or tinged with reddish-brown. Stems *1–2·5 cm long*, soft, brittle, green or brownish, simple, *frequently with thin, distant-leaved innovations*, ascending to suberect. *Leaves distant, squarrose*, very slightly oblique, rotund-quadrate, $\frac{1}{3}$ bilobed, sinus obtuse, almost right-angled, lobes acute or obtuse; cells 28–36 μ, irregularly polygonal, trigones minute or the walls almost equally thin throughout. Subinvolucral bracts erecto-patent, conduplicate-concave, broad, 2–3-lobed, lobes dentate or entire, the antical margin with an additional tooth. Involucral bracts *plicate*, irregularly 2–5-lobed, lobes acute, dentate or sometimes entire; bracteole ovate-lanceolate, dentate, connate with one or both bracts. Perianth *large*, *longly exserted*, *cylindrical or cylindrical-clavate*, *smooth*, only the mouth plicate, crenulate.

Forma **Limprichtii** (Lindb.) Massal., Spec. ital. gen. Jung. p. 18 (1895).

Jungermannia excisa Nees, Eur. Leb. II p. 98 (1836).
Jungermannia Limprichtii Lindb., Musc. Scand. p. 7 (1879); Limpr., Krypt. Fl. Schles. p. 282 (1876).
Lophozia Limprichtii Steph., Spec. Hep. II p. 137 (1901).

Small. In frequently reddish patches on dry soil. Leaves *closely imbricate*, ascending, antically secund, *not undulate*. Involucral bracts embracing the perianth, not crispate. Perianth *small and narrow*, oblong-cylindrical, *frequently reddish*. Gemmae usually numerous.

Forma **arenaria** (Nees) Schiffn., Krit. Bemerk. in Lotos no. 7 p. 17 (1903).

Jungermannia arenaria Nees, Eur. Leb. II p. 132 (1836); Warnst., Krypt. Fl. Mark Brand. p. 187 (1902).

Small and tender, green. Leaves *distant*, *frequently almost canaliculate-concave*. Involucral bracts more or less crispate. Perianth very longly exserted, *cylindrical*, the mouth plicate.

HAB. Banks and old walls, usually sheltered.

DISTRIB. N. to Caithness, uncommon; Ireland. Fr. Mar.–Oct.

Is only likely to be mistaken for *L. ventricosa*, but the paroicous inflorescence, which is nearly always in evidence, will distinguish it; the cell structure is also more delicate, with its thin walls which are very slightly or not at all thickened at the angles. The cells of the lower leaves are empty and colourless, but those of the upper leaves are filled with chlorophyll; the leaves of the sterile stems are occasionally squarrose. In the typical plant the bracts form a crispate head at the apex of the stem until the perianth lengthens, and even then they are closely imbricated and more or less crispate or undulate. The involucral bracts are frequently connate with one another to the middle; they loosely surround the perianth.

Alicularia Geoscyphus has a somewhat similar habit to the present plant, but the leaves are seldom more than emarginate, the trigones are larger, and the perianth is quite different.

The plants of the *L. excisa* group have been variously treated by authors; the most important synonyms are given under each form. Schiffner has shown that all these forms may be combined in one patch and connected with intermediate forms.

The *f. cylindracea* differs from the type in being larger, the leaves squarrose, in the thin, distant-leaved innovations, the perianth more cylindrical, and plicate only at the mouth. It nearly always occurs as scattered stems among mosses, especially *Dicranum*, and apparently never forms the rather compact tufts which the typical plant does.

The *f. Limprichtii* is the small xerophytic state. It is frequently conspicuous on dry banks on account of its reddish gemmae.

The *f. arenaria* is generally found in sandy ground, as the name implies. It is a tender plant, with some of the sterile stems having concave, channelled leaves.

109. Lophozia incisa (Schrad.) Dum.

Jungermannia incisa Schrad., Syst. Samml. Krypt. Gew. 2 p. 5 (1796).
Jungermannia viridissima Nees, Eur. Leb. II p. 134 (1836).
Lophozia incisa Dum., Rec. d'obs. p. 17 (1835).

1. Stem. 2. Leaf. 3. Cells. 4. Gemmae.

Dioicous. In compact, depressed, *bluish-green* patches. Stems short and *thick*, 4–10 mm long, prostrate or ascending, furcate at the apex or sparingly branched; rhizoids long, numerous and crowded, colourless, to apex of stem. Leaves almost transversely inserted, half embracing the stem, horizontal, the lower distant, subcomplicate, unequally bilobed, the upper *plicate-crispate*, forming a *crowded head at the apex of the stem*, irregularly *2–5*-lobed, the lobes more or less *dentate or spinous-dentate;* cells 27–36 μ, roundish-quadrate, *opaque* through numerous chlorophyll granules and oil-bodies, *thin-walled*, trigones small but distinct; cuticle smooth. Underleaves absent. Involucral bracts larger than the leaves, plicate-crispate, irregularly 3–5-lobed, the lobes *spinous-dentate;* bracteole lanceolate or absent. Perianth narrowly obovate, obtusely plicate at the apex, the mouth *ciliate*-dentate. Capsule oval, reddish-brown, the valves *carmine*. Spores 10–12 μ, finely granulate, brown. Elaters reddish-brown. ♂ bracts forming a crowded head at the apex of the stem, ventricose; antheridia 1–2, large, globose. Gemmae *greenish-yellow*, in clusters at the apex of the leaf-lobes, 1–2-celled, pyramidal or irregularly 3–5-angled.

Hab. Moist peaty banks, moors and stumps, seldom on sand rocks, ascending to 3600 ft. alt.

Distrib. N. to Shetland, frequent; Ireland. Fr. June–July, rare.

The thick stem of this plant is generally sufficient in itself to distinguish the species. The leaf-cells are very chlorophyllose and opaque, and differ in this respect from *L. ventricosa*, as well as by their larger size. The crisped, more or less dentate and unequally lobed upper leaves are also unlike what is found in *L. ventricosa*, and the capsule-wall is of a brighter red.

In the field the blue-green colour of this species generally attracts the eye as being different from that of any other species of similar habitats. It does not retain this colour when dried, but becomes dark green or almost black.

A closely related species of somewhat high elevations is *Jung. grandiretis* Lindb., Medd. Soc. F. F. Fenn. 9. p. 158 (1883). It is larger than *L. incisa*, with the underside of the stem dark red, leaves broader than long and with larger cells, which have also more thickened walls.

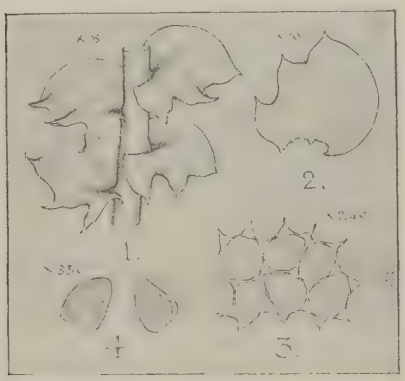
Subgen. Barbilophozia (Loeske) K. Müll.

Jungermannia C. *Barbatae* 2. *Amphigastriatae* p.p. G. L. N. Syn. Hep. p. 118 seq. (1844).
Barbilophozia Gen. Loeske, Verh. Bot. Ver. Prov. Brand. 49 p. 37 (1907).
Barbilophozia K. Müll., Rabh. Krypt. Fl. I p. 622 (1910).

Leaves generally 3–4-lobed, the base of postical margin frequently with cilia and the lobes cuspidate or bristle-pointed, the leaves seldom 2–lobed or with obtuse lobes. Underleaves usually present and large, bifid and ciliate. Perianth ovate, plicate in the upper half. Dioicous.

110. Lophozia quinquedentata (Huds.) Cogn.

Jungermannia quinquedentata Huds., Fl. Angl. p. 511 (1762).
Jungermannia barbata var. *quinquedentata* Nees, Eur. Leb. II p. 196 (1836).
Jungermannia Lyoni Tayl., Trans. Bot. Soc. Ed. p. 116 (1844).
Lophozia quinquedentata Cogn., Bull. Soc. Roy. Bot. Belg. 10 p. 279 (1872).
Lophozia Lyoni Steph., Spec. Hep. II p. 149 (1901).



1. Stem. 2. Leaf. 3. Cells. 4. Gemmae.

Dioicous. In loose, frequently depressed, *dark yellow-green* tufts. Stems 2–5 cm long, green or brown, frequently dark brown underneath, procumbent or ascending, sparingly branched; rhizoids numerous, dense, colourless or fuscous. Leaves imbricate, patent with the upper half usually reflexed, somewhat undulate, when dry crispate, *asymmetrical, the postical margin greatly arched and much longer* than the almost transversely inserted *antical margin*,

unequally *3-lobed*, sinus acute or obtuse, *postical lobe large*, obtuse and apiculate, the other lobes *smaller*, *cuspidate* or acute; cells 23–28 μ, rounded-polygonal, walls thin, *trigones large*; cuticle verruculose. *Underleaves absent.* Involucral bracts erect with the apex patent, very broad, nearly equally 3–4,- rarely 5,-lobed, plicate, the lobes sometimes dentate; bracteole variable, more or less bilobed, highly connate with the bracts. Perianth oblong-obovate, pluriplicate at the apex, the mouth shortly lobed and unequally *ciliate*, cilia to 4 cells long, or sometimes longer. Capsule oblong-oval, yellow-brown. Spores 13–15 μ, verrucose, yellow-brown. Elaters reddish-brown. ♂ bracts terminal in several pairs, *crispate*, saccate at base, the antical lobe erect and inflated; antheridia 2–3, subglobose, shortly pedicellate. Gemmae yellow-green at the apex of the upper leaf lobes, irregularly and obtusely 3–4-angled and 2-celled, or elliptical to oval and usually 1-celled.

HAB. Moist banks, old walls, tree stems and rock ledges, subalpine to alpine, ascending to 4000 ft. alt.

DISTRIB. Devonshire to Shetland, frequent to common, except in the south; Ireland. Fr. June–Sept.

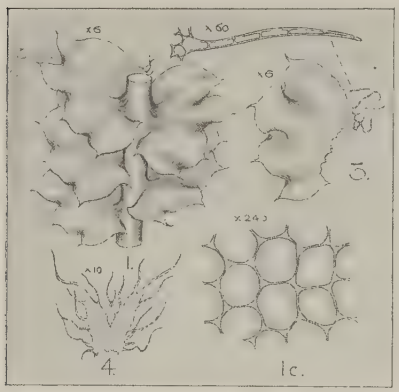
The most distinct and least variable of the *Barbilophozia* subgenus, and easily recognised. The leaves are almost always 3-lobed and markedly asymetrical, the postical margin being much longer than the antical, strongly arched and always without teeth or cilia at base; the postical lobe is also much the largest; the antical lobe is narrowly triangular and longly pointed; underleaves are absent. The involucral bracts are not rarely 4-lobed, and are occasionally 5-lobed on one side while the other is 3-lobed. The ♂ plant is common, and as the bracts are crispate, it is sometimes mistaken for *L. Floerkii* or *L. lycopodioides*, but there is practically no resemblance between it and these species. Perianths are rather common and fruit is frequent. Gemmae are rare.

111. Lophozia lycopodioides (Wallr.) Cogn.

Jungermannia lycopodioides Wallr., Fl. Crypt. Germ. 3 p. 76 (1831).
Jungermannia barbata var. *lycopodioides* Nees, Eur. Leb. II p. 185 (1836).
Lophozia lycopodioides Cogn., Bull. Soc. Roy. Bot. Belg. 10 p. 278 (1872).

Dioicous. In loose depressed pale green or *yellow-green*, seldom brownish tufts. Stems to 5 cm long, green above, brownish underneath, *prostrate or ascending*, sparingly branched; rhizoids dense and rather short, colourless. Leaves imbricate, *crispate*, horizontal, *asymmetrical*, *very obliquely* inserted, broader than long, *4-lobed* to $\frac{1}{4}$, occasionally 3- or 5-lobed, sinus *acute at base* or round, frequently gibbose, lobes *broadly triangular*, somewhat unequal, *apiculate to mucronate* or obtuse, the antical margin *rather longly* decurrent, *shorter*

than the postical margin, the latter with *long cilia at base, having cells several times longer than broad*; cells 21–28 μ, rounded-polygonal, walls thin, trigones small and distinct; cuticle nearly smooth. *Underleaves large*, usually deeply bifid, *longly fimbriate-ciliate*. Involucral bracts erect, resembling the leaves but more plicate, the lobes *frequently ending in a long cilium* and both antical and postical margin of bract with cilia at base; bracteole large, bifid and longly ciliate. Perianth oblong, plicate at apex, the mouth shortly incised and longly ciliate, cilia 1–3 cells long. Capsule dark brown, ovate-oval. Spores 12–14 μ, muriculate, brown. ♂ bracts closely imbricate, concave, saccate at base; antheridia several, large, oval-globose. Gemmae in vinous-red clusters on the leaf-lobes at the apex of the stem, irregularly and obtusely 3-many-angled, 1–2-celled, rare.



1. Stem with leaves. 1c. Cells. 3. Leaf, with basal cilium enlarged. 4. Underleaf.

Hab. Moist alpine rock ledges and wet grassy ground, 2500–4000 ft. alt.

Distrib. West Inverness and Perth to Sutherland, very rare.

Rare and confined to the upper parts of our higher mountains; the subalpine records of this species must be transferred to *L. Hatcheri*, with which it has been until recently often confused; it is not likely to be mistaken for any other species. It is a larger plant than *L. Floerkii*, more crispate, leaves usually 4-lobed, more oblique and more longly decurrent, lobes frequently apiculate or even cuspidate and not incurved, the postical margin with cilia having long cells, and the underleaves more ciliate. The former difficulty in distinguishing between *L. Floerkii* and *L. lycopodioides* has almost disappeared since Schiffner separated *L. Hatcheri* from them, as the latter species includes nearly all the forms which were supposed to unite the two.

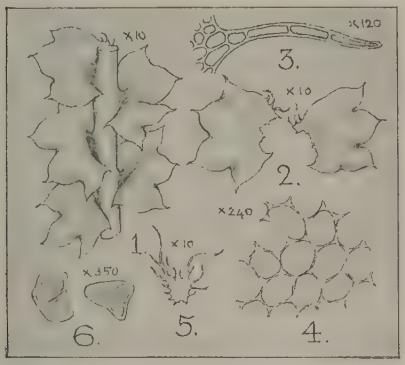
112. Lophozia Hatcheri (Evans) Steph.

Jungermannia Hatcheri Evans, Bull. Torr. Club p. 417 (1898).

Jungermannia Floerkii var. *Baueriana* Schiffn., Oest. Bot. Zeit. No 8 p. 6 reprint (1900).

Lophozia Hatcheri Steph., Spec. Hep. II p. 151 (1901); K. Müll. Rabh. Krypt. Fl. I p. 631 (1910).

Lophozia Baueriana Schiffn., Krit. Bemerk. in Lotus No 7 p. 9 reprint (1903). *Jungermannia Baueriana* Arnell, Bot. Notis. p. 145 (1906).



1. Stem. 2. Leaves. 3. Basal cilium of do. 4. Cells. 5. Underleaf. 6. Gemmae.

Dioicous. In dark green to reddish-brown loose tufts. Stems 2–5 cm long, green or brown, flexuous, ascending or erect, sparingly branched; rhizoids dense and mostly short, colourless. Leaves *very variable*, imbricate to approximate, horizontal and flat, or ascending and somewhat concave, *about as broad as long or slightly broader*, more or less obliquely inserted, the antical margin slightly decurrent, generally shorter than the postical margin, or the leaves symmetrical, *3–4-lobed*, *most commonly 4-lobed*, to $\frac{1}{4}$ or $\frac{1}{3}$, sinus obtuse or acute and more or less *gibbose*, lobes *ovate*, usually convex, subacute or obtuse, generally apiculate or cuspidate, *one or more usually ending in a long cilium composed of several cells*, rarely all the lobes obtuse, base of postical margin with *1–3 long cilia*, *having cells several times longer than broad*; cells 20–25 μ, nearly all of the same size, rounded-polygonal, walls thin, trigones small and generally distinct; cuticle verruculose. Underleaves large, deeply bifid, *longly ciliate*. Involucral bracts with several lobes, the lobes *ending in long cilia*. ♂ bracts terminal or below the apex, in 5–7 pairs, imbricate, concave, the lobes incurved, saccate at base, asymmetrical, the antical lobes smaller; antheridia 2–5, broadly oval, shortly pedicellate. *Gemmae in vinous-red clusters* on the leaf-lobes at the apex of the stem, irregularly and obtusely 3–many-angled, occasionally some oblong-ovate or oval, 1–2-celled, *frequent*.

HAB. Banks, among rocks, subalpine and occasionally alpine, ascending to at least 2600 ft. alt.

DISTRIB. Wales to Caithness, widely distributed but uncommon.

A very variable species and sometimes distinguished with difficulty from *L. lycopodioides*, though in most instances it is readily recognised. A form occurs with the leaves mostly only 3-lobed, somewhat concave and the lobes mostly obtuse, which much resembles *L. Floerkii*, but even in this case, bristle-pointed lobes may always be seen here and there. The present plant can be

generally known from *L. Floerkii* by the leaves being much more frequently 4–lobed, the lobes more unequal, one or more being usually bristle-pointed, and the base of the postical margin occasionally with long cilia which also have long cells; gemmae are also frequently present and ♂ plants are common.

It differs from *L. lycopodioides* in being usually smaller and darker coloured, leaf-cells smaller, leaves more symmetrical and more frequently 3–lobed, lobes not deeply divided, ovate instead of broadly triangular and more frequently ending in a long bristle, sinus more often gibbose; also in the frequent presence of ♂ plants and gemmae, both being rare in *L. lycopodioides*. However some forms can only be doubtfully separted from that species, and there seems to be no doubt that intermediate forms do occur. The present plant is much the most common and has its head quarters in the subalpine region, while the other is entirely alpine in Britain.

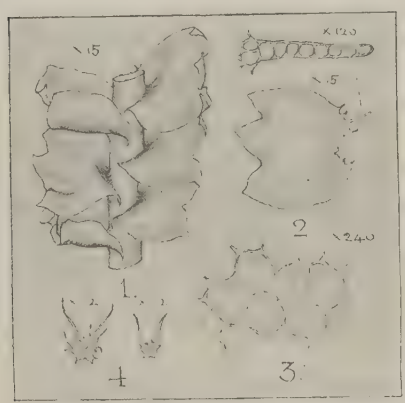
L. barbata has differently shaped leaves, lobes never bristle-pointed, underleaves absent or less developed, and cilia are absent at the base of the postical leaf-margin.

Perianths and fruit are very rare in *L. Hatcheri*.

Müller has had the opportunity of examining the original specimen of *L. Hatcheri* from Patagonia and specimens from other localities in the Antartic. He feels no doubt that it is the same species as *L. Baueriana Schiffn.* from Europe. Loeske in *Verh. d. Bot. Prov. Brand.* p. 37, (1907) had already considered the two plants to be the same species and named it *Barbilophozia Hatcheri*, but later he was doubtful of this being correct.

113. Lophozia Floerkii (Web. et Mohr) Schiffn.

Jungermannia Floerkii Web. et Mohr., Bot. Tasch. p. 410 (1807).
Jungermannia barbata var. *Floerkii* Nees, Eur. Leb. II p. 168 (1836).
Jungermannia lycopodioides var. *Floerkii* Lindb., Musc. Scand. p. 7 (1879).
Lophozia Floerkii Schiffn. in Engl. and Prantl I 3 p. 85 (1893).



1. Stem. 2. Leaf, with basal cilium enlarged. 3. Cells. 4. Underleaves.

Dioicous. In pale green to dark green or brownish loose or compact tufts, frequently forming extended masses. Stems to 5 cm long, seldom longer, green or brown, rigid and flexuous, *ascending or erect*, sparingly branched; rhizoids dense and rather short, colourless. Leaves imbricate, *symmetrical*, ascending, *slightly* obliquely inserted, *quadrate* - rotund, *3–lobed*, sinus gibbose, lobes broadly ovate, subequal, *incurved*, acute or obtuse, antical margin shortly decurrent,

equalling in length the postical margin, the latter with *1–4 cilia at base, having the cells hardly longer than broad*; cells 21–26 μ, rounded-polygonal, walls thin, trigones small and distinct; cuticle verruculose. *Underleaves large*, usually deeply bifid, the margins more or less longly ciliate. Involucral bracts erect, embracing the perianth, plicate above and crispate, shortly 3–7-lobed, lobes variable, *obtuse or cuspidate*; bracteole broad, more or less ciliate. Perianth nearly cylindrical, plicate, narrowed at the apex, mouth shortly ciliolate, the cilia one cell long. ♂ bracts terminal, in 4–7 or more pairs, imbricate, concave, saccate at base, the antical margin with a tooth at base; antheridia 2–3, oval-globose, shortly pedicellate. *Gemmae absent* or very rare.

var. **Naumanniana** Nees, Eur. Leb. II p. 170 (1836).

Larger than the typical plant, in swelling yellowish-green tufts in wet ground. Leaves more distant, widely spreading, or squarrose, usually flat, sometimes channelled, rarely crispate.

Hab. Banks and among rocks and rocky ledges, subalpine and alpine, ascending to 4000 ft. alt. Var. *Naumanniana*, in marshes.

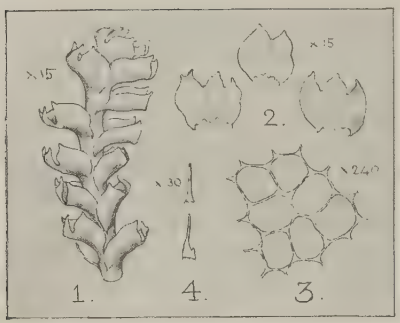
Distrib. Devonshire to Shetland, rare in the south, frequent to common elsewhere, except in the West Highlands; Ireland.

This species occurs in many forms and is sometimes confusing. The nearly constantly 3-lobed leaves with the postical teeth or cilia having short cells, and the distinct underleaves, make it readily known as a rule; in most cases the lobes are incurved. The leaves are frequently broader above the middle than below, and in some forms are almost transversely inserted, and they are not seldom only 2-lobed on slender stems; when this occurs in depauperate plants the underleaves are frequently subulate and almost entire. The lobes are sometimes acute but probably never bristle-pointed; the sinus is not always gibbose. The cilia at the base of the postical leaf-margin are sometimes reduced to a tooth or process. Perianths are uncommen and fruit has not, I believe, been seen in Britain, though sterile ♀ inflorescence is common. ♂ plants are uncommon and gemmae are rare, if they occur at all; the descriptions of gemmae by authors must be transferred to *L. Hatcheri*.

114. Lophozia atlantica (Kaal.) Schiffn.

Jungermannia atlantica Kaalaas, Beitr. Leb. Norw. in Videns. Skr. No 9 p. 11 (1898).

Lophozia atlantica Schiffn., Krit. Bemerk. in Lotus p. 46 reprint (1901); K. Müll., Rabh. Krypt. Fl. I p. 652 (1910).



1. Stem. 2. Leaves. 3. Cells. 4. Underleaves.

Dioicous. Resembling *L. attenuata*. *Small.* In loose, but intricate, greenish-brown to brown tufts. Stems 1–2 cm long, green or brown, flexuous, ascending, simple or branched, *without small-leaved innovations from the apex of the stem*; rhizoids scarce or rather numerous, colourless. Leaves imbricate, patent to erecto-patent, *subcomplicate-concave, almost transversely inserted*, the margin of antical lobe shortly decurrent, *2–4-lobed*, being 2-lobed and broadly oval or 3-lobed and obovate-quadrate to rotund-quadrate, more rarely 4-lobed, sinus acute or obtuse, not gibbose, lobes subequal, incurved, *the postical rather the smaller*, triangular or ovate, acute to subacute, postical margin *without teeth or cilia at base*; cells *16–23* μ, quadrate-hexagonal, walls somewhat thickened, trigones small; cuticle striate-verruculose. *Underleaves few*, small, near apex of stem and branches, subulate to lanceolate, or absent.

Hab. On rather dry soil among rocks, subalpine.

Distrib. Lancashire to Caithness, rare.

Intermediate between *L. Floerkii* and *L. attenuata* and frequently separated with difficulty, especially from the latter. It differs from *L. attenuata* in the constant absence of the small-leaved innovations from the apex of the stems, the more varying number of leaf-lobes, of which there are very frequently only two, and in the underleaves being frequent in the younger parts of the stem and branches; the leaves are also sub-complicate, more transverse, and the lobes more incurved, and the cells rather larger; it is more confined to the west side of the country.

There is a small form of *L. Floerkii* with only a few subulate underleaves, which is much like *L. atlantica*, but even in this form the underleaves are rather more in evidence, the leaves generally more oblique, the postical margin has occasionally a tooth at the base and the cells are rather larger. In general, *L. Floerkii* is easily separated by its larger size, oblique leaves, distinct teeth or cilia at base of postical margin and the large underleaves which are more or less ciliate.

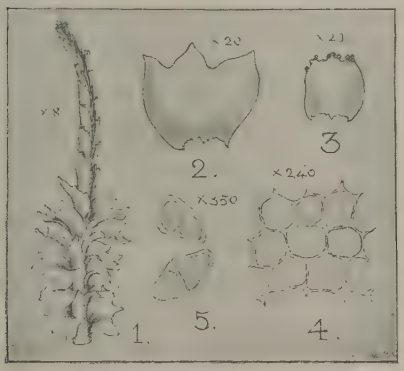
115. Lophozia attenuata (Mart.) Dum.

Jungermannia gracilis Schleich., Pl. Crypt. Helv. Exs. 3 no. 60 (1804); Lindb., Musc. Scand. p. 7 (1879).

Jungermannia quinquedentata δ attenuata Mart., Fl. Crypt. Erlang. p. 177 (1817).

Jungermannia attenuata Lindenb., Syn. Hep. p. 48 (1829).

Lophozia attenuata Dum., Rec. d'obs. p. 17 (1835).
Jungermannia barbata var. *attenuata* Nees, Eur. Leb. II p. 163 (1836).
Lophozia gracilis Steph., Spec. Hep. II p. 147 (1902).



1. Gemmiferous stem. 2. Lower leaf. 3. Upper leaf. 4. Cells. 5. Gemmae.

Dioicous. In loose, but intricate, green to brown tufts. Stems 1·5–4 cm long, green or brown, flexuous, ascending, simple or branched, *with slender and almost cylindrical densely imbricated, appressed-leaved innovations from the apex of the stem*; rhizoids usually numerous except on the innovations, colourless. Leaves imbricate or approximate, patent to erecto-patent, *concave, slightly* obliquely inserted, the antical margin shortly decurrent, *obovate-quadrate, normally 3-lobed* to $\frac{1}{4}$–$\frac{1}{3}$, sinus acute or obtuse, *not gibbose* except near the perianth, lobes subequal, *the postical rather the smaller*, triangular-acute to subacute, postical margin *without teeth or cilia at base*; leaves on the innovations *erect, appressed*, transverse, concave, *oblong to subquadrate*, 2–3- or 4-lobed, *frequently gemmiferous and erose at apex*; cells *15–21* μ, quadrate-hexagonal, walls somewhat thickened, trigones small, sometimes indistinct; cuticle striate-verruculose. *Underleaves absent*, or rarely present and subulate to lanceolate. Involucral bracts larger than the leaves, embracing the perianth, the apex patulous, unequally 3–5-lobed, sinus gibbose, lobes acute or cuspidate; bracteole irregularly 2–4-lobed, lobes acute or cuspidate. Perianth longly exserted, oblong to cylindrical, obtusely plicate at the apex, the mouth unequally ciliate, *cilia to 6 cells long*. Capsule longly pedicellate, oval, bright red-brown. Spores 10–14 μ, *vinous red*, asperous. Elaters the same colour. ♂ bracts in the middle of the stem, in 5–7, or more, pairs, closely imbricated with the apex patulous, very concave, saccate at base, 3-lobed, sinus frequently gibbose, the antical margin with a tooth at base; antheridia 1–2, oval. *Gemmae pale green* at the apex of the leaves of the innovations and sometimes of the stem, irregularly angled, pyramidal or oval, 2-celled.

HAB. Subalpine banks, walls and stumps.

DISTRIB. N. to Caithness, frequent; Ireland.

The slender shoots, several of which may be sometimes noted together at the apex of the stems, render this species in general to be easily known. When these shoots are absent (var. *eflagellis* Schiffn.), the plant bears some resemblance to small forms of *L. Hatcheri*, but the present species never has bristle-pointed leaf-lobes or cilia at the base of the postical margin, nor has it ever well developed underleaves. The much smaller leaf-cells will distinguish it from any form of *L. Floerkii*, as well as the entire or almost entire absence of underleaves; also in *L. attenuata* the postical margin of the leaf is rather shorter, and the postical lobe rather smaller than the antical, the middle lobe being the largest.

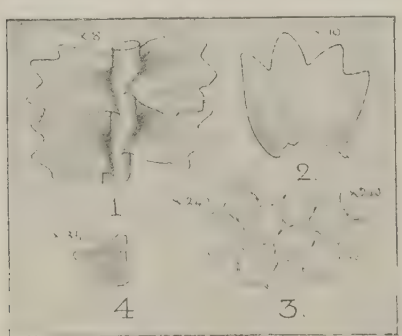
The leaves are broader at the apex than at the base, but in the innovations the apex is frequently truncate. Some leaves are frequently 2-lobed and a few are occasionally 4-lobed. A form occurs with the leaves mostly 2-lobed, which might be confused with *L. ventricosa*, but the smaller leaf-cells alone will distinguish it from that plant. The walls and angles of the leaf-cells are sometimes considerably thickened, so much so as to be almost guttulate. The cilia of the mouth of the perianth are stiff and bristle-like, with a few 1-celled teeth among them.

Evans has pointed out in *Rhodora* p. 187, 1908 that Schleicher's *Jungermannia gracilis* is a *nomen nudum*, the name only appearing in a set of exsiccata without diagnosis.

A related species is *L. Binsteadii* (Kaal.) Evans, the original description of which was published by Kaalaas in his *Beitr. zur Leb Norv.* p. 9, 1898. This may be expected to occur, among mosses in moist ground, on some of our higher hills. It resembles a slender form of *L. quinquedentata* a good deal in habit, and is without underleaves, but it is yellowish to reddish-brown in colour; the leaves are antically secund with the lobes bluntly pointed and incurved.

116. Lophozia barbata (Schmid.) Dum.

Jungermannia barbata Schmid., Icon. Pl. p. 187 (1747) et Diss. de Jung. p. 20 (1760).
Lophozia barbata Dum., Rec. d'obs. p. 17 (1835).
Jungermannia barbata var. *Schreberi* Nees, Eur. Leb. II p. 189 (1836).



1. Stem. 2. Leaf. 3. Cells. 4. Gemma.

Dioicous. In loose depressed *brownish-yellow*, less frequently dark green tufts. Stems to 5 cm long, stout and flexuous, brown, procumbent or ascending, simple or furcate with long branches; rhizoids short and dense, colourless. Leaves imbricate, *flat*, *horizontal*, *symmetrical*, *very obliquely* inserted, *not crispate when dry*, *obcuneate-quadrate*, 4-lobed, occasionally 3- or 5-lobed, sinus undulate and obtuse, lobes subequal,

ovate-triangular to ovate-oval, *obtuse* or more seldom acute, the antical margin decurrent, of *almost the same length* as the *nearly straight* postical margin *which is without teeth or cilia at base*; cells 23–28 μ, rounded-polygonal, opaque, walls thin, trigones small and distinct; cuticle granulate. *Underleaves generally absent*, when present small and subulate, more rarely large and lanceolate or bifid with the margins entire or ciliate. Involucral bracts erect, resembling the leaves but more deeply lobed, the sinus frequently gibbose, lobes longer and more or less spinous-dentate; bracteole bifid, variously laciniate. Perianth oblong, plicate at the apex, the mouth lobed and *dentate*. Capsule rotund-oval, brown. Spores brown, verrucose. ♂ bracts terminal, closely imbricate, ventricose, the antical margin with 1–2 teeth; antheridia 2–5, oval, large. Gemmae in reddish-yellow clusters at the apex of the leaf-lobes, 3–6-angled or oblong, 1–2-celled.

Hab. Moist walls and banks, ascending to 2700 ft. alt.

Distrib. N. to Shetland, uncommon; Ireland.

A distinctly marked species which seldom gives rise to difficulty; the very obliquely inserted, horizontal leaves, generally flat both when wet and dry, and the four obtuse lobes almost parallel to the stem, render it in most cases easily known. There are frequently some leaves which are 3-lobed and occasionally a few which are 5-lobed, but the greater part are nearly always 4-lobed. Underleaves are normally absent, but they are sometimes present, and occasionally large. A form occurs which has less oblique leaves, mostly 3-lobed and concave, and bears some resemblance in habit to *L. Floerkii*, but the postical margin is always without teeth or cilia, the underleaves are absent or poorly developed, and an examination of the young leaves at the apex of the stem will generally show the characteristic marks of *L. barbata*.

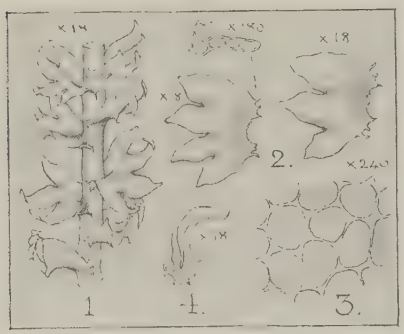
Perianths are rather frequent, but mature fruit is very rare; ♂ plants and gemmae are rare.

117. Lophozia quadriloba (Lindb.) Evans

Jungermannia quadriloba Lindb., Soc. F. Fl. Fenn. 1883 et Musc. Asiae Bor. p. 55 (1889).
Lophozia quadriloba Evans, Proc. Wash. Acad. p. 304 (1900).
Sphenolobus quadrilobus Steph., Spec. Hep. II p. 168 (1902).

Dioicous. *Slender*. Loosely tufted or as scattered stems among mosses, *olive-green to fuscous* or almost black in colour. Stems 3–4 cm long, brown or black, rigid, *erect* or ascending, simple or furcate, *terete-foliate;* rhizoids numerous, colourless. Leaves remote or imbricate, almost *transversely* inserted, *semi-amplexicaul*, *concave*, the antical margin shortly or hardly decurrent, broadly obcuneate to *transversely elliptic*, *3–4-lobed to the middle or beyond*, occasionally some leaves 2-lobed, *sinus narrow*, *strongly gibbose and recurved*, lobes oblong

to triangular-ovate, acute or subacute, sometimes one or more obtuse, incurved, their margins *reflexed, postical margin and generally also the antical margin with 1–3 cilia or teeth at base having cells only slightly longer than broad;* cells 18–28 μ, rounded-polygonal, walls somewhat thickened, trigones large, indistinct; *cuticle coarsely verrucose.* Underleaves *large*, bifid to the base, segments long, lanceolate-subulate, *almost filiform towards the apex*, the base with 1–3 cilia.



1. Stem. 2. Leaves, with basal cilium enlarged. 3. Cells. 4. Underleaf.

Involucral bracts larger than the leaves, erecto-patent, 4–5-lobed to the middle, lobes less incurved, the basilar teeth larger; bracteole very similar to the bracts but narrower. Perianth (immature) cylindrical-obovate, obtuse, plicate above, mouth large, irregularly dentate, the teeth short, incurved, serrate. ♂ bracts closely imbricate, saccate at base, 4-lobed to the middle, lobes obtuse and more incurved; antheridia 2–3, oval, large, shortly pedicellate. Gemmae (*teste* Arnell) yellowish, at the apex of the upper leaf-lobes, variously shaped, mostly rhomboid, sometimes triangular or ovate, thick-walled, 2-celled.

Hab. Alpine rock ledges from 1900–3000 ft. alt.

Distrib. Ben Lawers district, very rare.

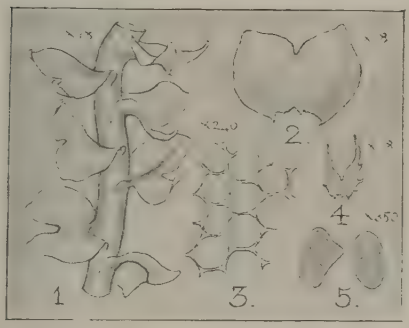
Is a more slender plant than *L. Floerkii* with which it might be confused, and it also differs, among other points, in being terete-foliate, leaves more transverse, semi-amplexicaul and more concave, more deeply lobed, lobes most commonly four with their margins more reflexed and the sinus strongly gibbose, cell-walls more thickened, especially at the angles, and the cuticle coarsely verrucose. It is intermediate in character between that species and *L. Kunzeana;* in the latter the leaves are almost all bilobed in British specimens.

The leaves are commonly considerably broader than long, and although they are mostly 4-lobed, a good number of them are only 3-lobed; they are rather seldom 2-lobed except on the branches: the lobes are most frequently acute and are sometimes acuminate; the sinus is very narrow and so much reflexed that the lobes often appear as if constricted at the base. The cilia at the base of both margins of the leaf vary; one at least is nearly always present on the postical side and generally also on the antical, but the latter is frequently reduced to a small tooth and may require some care to detect.

It has only been found sterile in Britain. Gemmae appear to be very rare everywhere and have only been noted by Arnell.

118. Lophozia Kunzeana (Hüb.) Evans

Jungermannia Kunzeana Hüben., Hep. Germ. p. 115 (1834).
Lophozia Kunzeana Evans, Proc. Wash. Acad. p. 305 (1900).
Sphenolobus Kunzeanus Steph., Spec. Hep. II p. 160 (1902).



1. Stem. 2. Leaf. 3. Cells. 4. Underleaf. 5. Gemmae.

Dioicous. In scattered stems among mosses or loosely tufted, *yellow-brown*, more rarely green. Stems 2–4 cm long, yellowish-brown, rigid, *erect* or ascending, sparingly branched; rhizoids long, numerous, colourless. Leaves imbricate or remote, the lower horizontal, the upper erecto-patent or nearly erect, almost *transversely* inserted, the antical margin hardly decurrent, semi-amplexicaul, *obtusely conduplicate-concave* from a *shortly sheathing base*, subquadrate to subrotund, generally broader than long, $\frac{1}{4}$–$\frac{1}{3}$ *bilobed*, a few occasionally 3-lobed, sinus narrow at base and frequently gibbose, *lobes broadly ovate with rounded apex, incurved*, postical margin at base *usually unarmed*, but sometimes with a tooth or with weak cilia; cells *18–25* μ, quadrate-hexagonal, walls somewhat thickened, trigones generally small; cuticle striate-verruculose. Underleaves large, erecto-patent, divided almost to base into *two long subulate to lanceolate segments, entire or with 1–3 teeth* or cilia near base. Involucral bracts erect, broader than the leaves, undulate, with a tooth or lacinia at base of one or both margins, 4-lobed to $\frac{1}{3}$, sinus very narrow and gibbose, lobes ovate, subacute to obtuse, sometimes apiculate; bracteole oblong, bilobed to $\frac{1}{3}$, spinous-dentate at base. Perianth oblong-ovate, plicate at the apex, the mouth dentate-serrate. Capsule oval-elliptic, dark brown. Spores 10–14 μ, pellucid, pale red, minutely asperous. Elaters vinous-red. ♂ bracts shorter and more erect than the leaves, intricate, saccate at base, the lobes incurved. *Gemmae yellow-green*, in clusters on the apex of the upper leaf-lobes, irregularly angled or oval.

Hab. Alpine marshes and side of streams, 2700–4100 ft. alt.

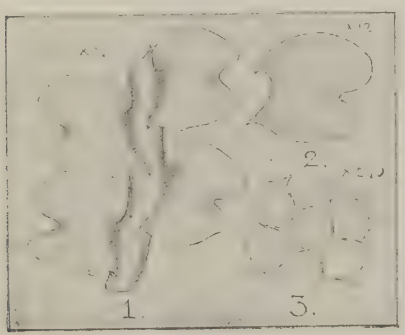
Distrib. West Inverness to Aberdeen, very rare.

The underleaves are sometimes much hidden by the rhizoids, and must not be overlooked on this account; they can usually be readily seen on some parts of the stem, and their presence will prevent confusion with other bilobed species with somewhat complicate leaves, as *L. alpestris*, etc. *L. Kunzeana* will probably not be mistaken for the other species of *Barbilophozia*, the most commonly bilobed leaves with the large, mostly bipartite underleaves being found alone in this plant, except rarely in *L. Floerkii*, but the latter has less deeply divided lobes. The var. *plicata* (Hartm.) which has not been found in Britain, has the leaves more imbricate and frequently with 3–4 lobes.

Some leaves have occasionally subacute lobes; the cell-walls vary in being thin or thickened, and the cells are notably larger at the base than at the margin. Although the underleaves are usually bipartite, some are occasionally undivided and lanceolate. Innovations from below the ♀ inflorescence are common; the subinvolucral leaves are frequently 3-lobed with the margins undulate. The involucral bracts are much like those of *L. quadriloba*.

119. Lophozia obtusa (Lindb.) Evans

Jungermannia obtusa Lindb., Musc. Scand. p. 7 (1879).
Lophozia obtusa Evans, Proc. Wash. Acad. 2 p. 303 (1900).



1. Stem. 2. Leaf. 3. Cells.

Dioicous. *In scattered stems among mosses*, or more rarely in loose tufts, green or yellow-green in colour. Stems 2–5 cm long, thick, flexuous, the postical side *reddish-purple*, ascending or suberect, usually simple with innovations from below the ♀ inflorescence; rhizoids *reddish-purple at base*, *short*, dense, numerous, to apex of stem. Lower leaves remote, the upper generally approximate to imbricate, *flaccid*, horizontal or occasionally suberect, the upper portion reflexed, *quadrate-rotund*, the antical margin shortly decurrent, $\frac{1}{3}$ bilobed, sinus rather *narrow*, obtuse and rounded at its *gibbose and recurved base*, *lobes broadly ovate*, *rotundate at apex*, somewhat unequal, the postical usually the larger; cells 20-30 μ, of nearly equal size throughout, oblong-rotund, 4–6-angled, the walls thin, *trigones small*: cuticle striate-verruculose. Underleaves triangular-subulate at the forking of the stems, *otherwise absent or rudimentary*. Involucral bracts erect or with the upper part reflexed, *smaller or of the same size* as the leaves, the margin frequently slightly dentate, *irregularly 2–4-lobed*, sinus obtuse or subacute, lobes acute or more seldom obtuse; bracteole large, variable

in shape, frequently bipartite. Perianth very longly exserted, *narrowly* cylindrical to cylindrical-clavate, smooth, plicate near the contracted apex, mouth dentate-ciliate, teeth sometimes slightly serrate. ♂ bracts terminal or at the middle of the stem, in 6–10 pairs, smaller than the leaves, nearly transverse, concave, saccate at base, the lobes *unequal*, *obtuse*, *incurved*; antheridia 2–3, globose. Gemmae pale green, angular, mostly 1-celled, at the apex of the leaf-lobes, rare.

HAB. Among mosses on shady banks and rock ledges, chiefly alpine, ascending to 3000 ft. alt.

DISTRIB. Wales to Highlands of Scotland, very rare.

This rare species is not difficult to recognise, the rotundate lobes not resembling those of any other, and the sinus is so markedly gibbose that the inner margins of the lobes are often connivent; some leaves are occasionally subacute or even acute or apiculate, especially on the antical lobes; the leaves on the innovations are commonly distant and variable in shape, and frequently acute or apiculate and sometimes 3-lobed. The almost entire absence of underleaves will prevent possible confusion with the larger members of the *L. Muelleri* group; the mouth of the perianth is not contracted into a tubular beak and the involucral bracts are unlike those in that group. The fertile plant is rare, and mature fruit has apparently not been seen; sterile perianths are short and broad. only the ♂ plant has been found in Britain.

The relationship of this species is doubtful. Lindberg places it in the *L. Muelleri* group and in this he is followed by Warnstorf: Massalongo places it in the *L. ventricosa* group and Schiffner inclines to place it between *L. ventricosa* and *L. alpestris* or alternatively in the *Barbiophozia* group. Kaalaas gives it as being near *L. Kunzeana* and in this has been followed by Müller with the reservation that it is also near *L. Wenzelii*.

XXIX. SPHENOLOBUS (Lindb.) Steph.

Jungermannia Subgen. *Sphenolobus* Lindb., Manip. Musc. Sec. p. 367–374. *Sphenolobus* Steph., Spec. Hep. II p. 156 (1901).

Plants similar to *Lophozia* but with *leaves transversely inserted*, shortly sheathing at the base, more or less *conduplicate-concave*, *usually bicleft and without underleaves* or with them rarely present and rudimentary. Dioicous.

This is an artificial genus separated from *Lophozia* on account of the transversely inserted, conduplicate leaves. Stephani in *Spec. Hep.* includes

Lophozia quadriloba and *L. Kunzeana* on this account, but the genus is more advantageously limited by omitting species which have the constant presence of underleaves and the frequent presence of postical cilia on the leaf margin. Schiffner has further suggested the elimination of those species which normally have 3-lobed leaves, and also their possible elevation to another genus which he has named *Tritomaria*.

1 { Leaves with three equal lobes, lobes obtuse ..... *125. politus*
  { Leaves 2-lobed, or with 2–3 unequal lobes..... 2

2 { Antical lobe reduced to a tooth, leaves with 2–3 unequal lobes 3
  { Antical lobe larger, leaves 2-lobed 4

3 { Gemmae elliptical, 12–17 μ; leaf-cells 10–17 μ. ..... *126. exsectus*
  { Gemmae angular, seldom pyriform, 17–26 μ; leaf-cells 22–34 μ. *127. exsectiformis*

4 { Leaves nearly parallel to stem, ⅔-bilobed; minute, reddish brown *124. Pearsoni*
  { Leaves patent to erecto-patent, ½ bilobed or less (except *S. ovatus*) 5

5 { Plant large; leaves closely imbricate postically, lobes appearing rounded; alpine ..... *120. saxicolus*
  { Small; leaves not closely imbricate postically, lobes usually pointed 6

6 { Minute, to 5 mm long, gemmiferous shoots present, gemmae 1-celled; on decaying wood..... *123. Hellerianus*
  { Larger, gemmiferous shoots absent, gemmae, if present, mostly 2-celled..... 7

7 { Postical lobe oblong-ovate, cells 14–21 μ, gemmae frequent..... *121. minutus*
  { Both lobes lanceolate, cells 19–27 μ, gemmae absent..... *122. ovatus*

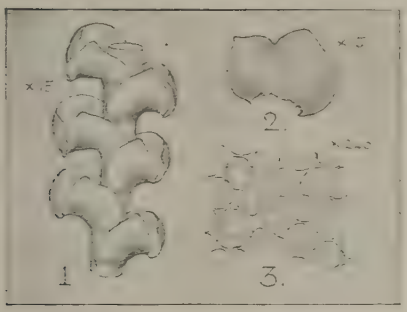
Subgen. Eusphenolobus K. Müll.

Eu-Sphenolobus K. Müll., Rabh. Krypt. Fl. I p. 588 (1910).

Leaves distinctly conduplicate-concave, 2-lobed, the lobes of equal size.

120. Sphenolobus saxicolus (Schrad.) Steph.

Jungermannia saxicola Schrad., Samml. Crypt. Gew. No. 97 (1796).
Jungermannia resupinata L., Fl. Suec. p. 400 No. 1038 (1755).
Diplophyllum saxicolum Dum., Rec. d'obs. p. 16 (1835).
Lophozia saxicola Schiffn. in Engl. and Prantl I 3 p. 85 (1893).
Sphenolobus saxicolus Steph., Spec. Hep. II p. 160 (1902).



1. Stem. 2. Leaf. 3. Cells.

Dioicous. In *compact depressed patches* or among mosses, *yellowish*-brown, more rarely olive green. Stems 2–3·5 cm long, brown, rigid and rather thick, procumbent, simple or sparingly branched, innovating from below the ♀ inflorescence; rhizoids somewhat numerous below, long and colourless, scarce above. Leaves imbricate or approximate, *convex and closely tiled postically*, flat in front, somewhat antically secund, transversely inserted, not decurrent, obtusely conduplicate-concave, rotund-ovate to quadrate-ovate, bilobed to the middle, sinus narrow, *gibbose and recurved*, the antical lobe ovate, *erect-patent*, acute or subacute, the apex slightly *incurved*, the *postical lobe larger*, *oblique*, obtuse, *incurved*; cells 18–24 μ, sometimes larger, roundish-quadrate, walls considerably thickened, the trigones rather large but somewhat indistinct; cuticle striate-verruculose. Underleaves absent. Involucral bracts slightly larger than the leaves, erect, concave, embracing the perianth, irregularly 2–4-lobed, lobes acute or bristle-pointed, the margins spinous-dentate or dentate-serrate. Perianth longly exserted, cylindrical-oblong, obtusely plicate at the apex, the mouth contracted, irregularly ciliate and dentate, the cilia to 6 cells long. ♂ plant more slender, bracts terminal, in few pairs, saccate at base; antheridia 1–3, oval-globose. *Gemmae absent.*

HAB. Rather dry alpine rocks, but descending to 1200 ft. alt.

DISTRIB. East Inverness; Aberdeen; Shetland: very rare.

Does not resemble any other species except perhaps *Scapania aequiloba*, with which plant it might be confused by the beginner. The *Scapania* can be readily distinguished by its leaves being sharply keeled and coarsely verrucose; the postical lobe is not or little convex, a few teeth are usually present on the margins of the upper leaves, and gemmae are nearly always to be found.

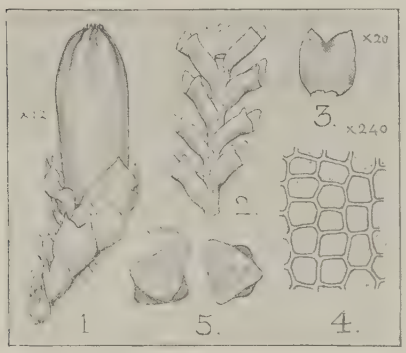
The absence of underleaves will distinguish the present plant at once from *Lophozia Kunzeana*.

By looking at a stem sideways, the convex postical side and the flat antical side are very noticeable. The antical lobes are very regularly placed, so much so as to look like the steps of a ladder when viewed from the front: they appear *in situ* as if obtuse or rounded on account of the apex being incurved.

The margins of the involucral bracts are variously armed with teeth, or even with an occasional cilium, down to the base: the lobes are sometimes only denticulate. Commonly one bract is 2-lobed and the other 4-lobed. The species does not vary much.

121. Sphenolobus minutus (Crantz) Steph.

Jungermannia minuta Crantz in Dicks., Pl. Crypt. Fasc. 2 p. 13 (1790).
Diplophyllum minutum Dum., Rec. d'obs. p. 16 (1835).
Lophozia minuta Schiffn. in Engl. and Prantl I 3 p. 85 (1893).
Sphenolobus minutus Steph., Spec. Hep. II p. 157 (1902).



1. Fertile plant. 2. Stem. 3. Leaf. 4. Cells. 5. Gemmae

Dioicous. Small. In intricate, brown, sometimes dark green, patches, or scattered among mosses. Stems 1·5–3 cm long, *filiform*, rigid and brittle, flexuous or *arcuate*, ascending to suberect, more or less branched, innovating from below the ♀ inflorescence; *rhizoids scarce*, colourless, *almost absent above*. Leaves imbricate to approximate, *small*, convex postically and flat in front, somewhat antically secund, very *regularly inserted*, *pectinate*, erecto-patent, transversely inserted and shortly sheathing at base, obtusely conduplicate-concave, rotund-quadrate, $\frac{1}{3}$ to nearly $\frac{1}{2}$ bilobed, the sinus narrow, acute, not gibbose or recurved, lobes broadly ovate, incurved, subequal or *the antical smaller*, acute or apiculate, the postical lobe frequently obtuse; cells 14–21 μ, subquadrate or irregularly angled, walls almost equally thickened, trigones being indistinct; cuticle minutely verruculose. Underleaves absent. Involucral bracts larger than the leaves, irregularly 2–4 lobed, lobes apiculate to acuminate, *margins entire*. Perianth longly exserted, cylindrical, plicate at the apex, the mouth contracted and shortly lobed, setulose and dentate. Capsule oval, brown. Spores 12–15 μ, brown, papillose. Elaters darker brown. ♂ bracts terminal, in 4–12 pairs, similar to the leaves but inflated at base; antheridia generally solitary, oval-globose. *Gemmae reddish-brown*, on the margins and apex of the upper leaves, tetrahedral or irregularly angled, *2 celled*.

var. **cuspidatus** Kaal., De Dist. Hep. in Norv. p. 376 (1893).

Usually green. Stems elongate, leaves distant, patent to squarrose, $\frac{1}{2}$ bilobed or deeper, lobes *greatly unequal*, *the antical lobe*

nearly parallel to the stem, arising abruptly from the postical lobe, narrow, *lanceolate to ovate-lanceolate*, *cuspidate* or acuminate; the postical lobe much larger, oblong-ovate, *apiculate to cuspidate*.

HAB. Peaty banks and among rocks; subalpine, seldom alpine, ascending to 3300 ft. alt.

DISTRIB. Wales to Shetland, uncommon; Ireland. Var. *cuspidatus*, Ben Arthur, Argyll. Fr. rare.

The transverse, semi-amplexicaul, small, pectinate leaves, of which the antical lobe is generally rather the smaller, and the filiform and frequently arcuate stems which are almost without rhizoids, will distinguish this species in most cases.

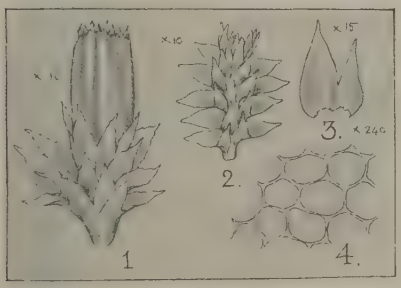
Marsupella Funckii, which is sometimes confused with it by beginners, is smaller, leaves less concave, more patent, more deeply lobed, the lobes equal, narrower and acute, not or hardly incurved; it also grows on bare soil in which the greater part of the stems are buried, and forms much more compact tufts which are nearly black in exposed places; the perianths, are, of course, quite different and gemmae are never seen.

The ♀ plant is often much branched. Fruit is rare, but gemmae are common.

It is a variable species but need rarely give rise to difficulty. Some forms, especially when in shady ground, have distant leaves with the lobes more or less acute. The var. *cuspidatus* is the extreme form with the lobes mostly cuspidate, and the antical lobe is narrow and nearly parallel to the stem, somewhat in the manner of *S. ovatus*, but the postical lobe is broad as in *S. minutus*, and the cells are much smaller than in the other.

122. Sphenolobus ovatus (Dicks.) Schiffn.

Jungermannia ovata Dicks., Plant. Crypt. Fasc. 3 p. 11 *pl.* 8 *f.* 6 (1793).
Jungermannia Dicksoni Hook., Brit. Jung. *pl.* 48 (1813).
Diplophyllum Dicksoni Dum., Rec. d'obs. p. 16 (1835); Pears., Hep. Brit. Isles p. 243 (1900).
Lophozia ovata Howe, Mem. Torr. Bot. Club 7 p. 111 (1899).
Sphenolobus ovatus Schiffn., Krit. Bemerk. in Lotos no. 3 p. 60 (1905).



1. Fertile plant. 2. Stem. 3. Leaf. 4. Cells.

Dioicous. In compact *olive-green* to *yellow*-brown tufts. Stems 5–15 mm long, somewhat rigid, flexuous or arcuate, prostrate with ascending apex, simple or sparingly branched, innovating from below the ♀ inflorescence; rhizoids long, colourless, to apex of stem. Lower leaves horizontal, the upper patent and somewhat antically secund, imbricate, transversely inserted, not decurrent,

obtusely conduplicate-concave, *unequally bilobed to* $\frac{3}{4}$, the sinus acute, *lobes lanceolate, entire* or obscurely sinuate-dentate near the apex, the postical lobe horizontal towards the base of the stem, *patent* to erecto-patent above, the antical lobe *narrower, suberect, nearly parallel to the stem*; cells 19–27 μ, rounded-quadrate, the walls somewhat thickened, trigones rather small; cuticle minutely verruculose. Underleaves absent. Involucral bracts rather larger than the leaves, erect, embracing the perianth, more equally bilobed, lobes more or less denticulate to spinous-dentate. Perianth oblong, *deeply plicate to near the base*, mouth broad, truncate, laciniate-ciliate, the cilia to 10 cells long. Capsule broadly oval, bright reddish-brown. Spores 14–16 μ, verruculose, vinous-red. Elaters vinous-red. ♂ bracts terminal in about 6 pairs, imbricate, resembling the leaves but lobes more equal, saccate at base; antheridia 1–2, broadly oval, shortly pedicellate.

Hab. Boulders and rocks in partial shade, and stems of birch trees, seldom on conifers, subalpine and alpine, ascending to 3000 ft. alt.

Distrib. Dartmoor and Wales to Sutherland and Caithness, rather rare; Ireland. Fr. April–Oct.

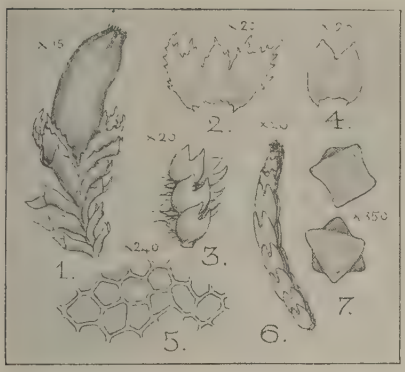
Will not probably be mistaken for any other species. The cuspidate forms of *S. minutus* have occasionally a slight resemblance to it, but gemmae are nearly always present in these and the leaf-cells are much smaller.

The leaves increase in size to some extent as they approach the perianth. The uppermost leaves are more inclined to be sinuate-dentate than those lower down the stem, and are sometimes even irregularly serrate near the apex. The postical lobe in the upper leaves is oblong-ovate, but is frequently longly acuminate, as is commonly the case in the lower leaves. The involucral bracts vary from being entire to serrate; frequently the postical lobe ends in a long cilium, and both lobes are often much acuminate. The ♂ inflorescence is terminal, but empty bracts are commonly seen at the middle of the stem. Gemmae have not been observed.

The position of this plant is doubtful; the rounded fold of the leaf, not keeled, separates it from our species of *Diplophyllum*, but there are other species which are placed with the latter genus, as *D. gymnostomum* Kaal., which seem to be related to our plant. Some forms of *S. minutus* resemble *S. ovatus* in the different direction of the two leaf-lobes, though the species are not closely allied. Opinions differ so greatly as to the species which should be assigned to *Diplophyllum*, that it seems preferable to retain the present plant in *Sphenolobus* until the former genus is more clearly differentiated.

123. Sphenolobus Hellerianus (Nees) Steph.

Jungermannia Helleriana Nees in Lindenb., Syn. Hep. p. 64 (1829).
Diplophyllum Hellerianum Dum., Rec. d'obs. p. 16 (1835).
Cephalozia Helleri Lindb., Meddel. Soc. F. Fl. Fenn. 14 p. 65 (1887).
Sphenolobus Hellerianus Steph., Spec. Hep. II p. 158 (1902).
Lophozia Helleriana Boulay, Musc. de la France II p. 94 (1904).



1. Fertile plant. 2. Bract. 3. Stem. 4. Leaf. 5. Cells. 6. Gemmiferous stem. 7. Gemmae.

Dioicous. *Very small.* In *yellow-green to brown* depressed patches on decaying wood. Stems to *5 mm* long, filiform, flexuous or *arcuate*, prostrate or ascending, simple or occasionally with several branches, innovating from below the ♀ inflorescence; *rhizoids numerous*, except on gemmiferous shoots, *to apex of stem*, long and colourless. Leaves small, somewhat distant, larger and imbricate towards the ♀ inflorescence, patent, somewhat antically secund, transversely inserted, not decurrent, obtusely conduplicate-concave, subquadrate, $\frac{1}{3}$ bilobed, the sinus acute and open, *lobes equal*, triangular, *acute or cuspidate*, slightly incurved; cells 16–24 μ, roundish-quadrate, *walls strongly and almost equally thickened;* cuticle verruculose. *Underleaves absent*, or rarely present and then scattered, small and subulate. Involucral bracts much larger than the leaves, erect, loosely embracing the perianth, 2–3-lobed, irregularly spinous-dentate; bracteole variable, dentate or spinous-dentate, connate with one or both bracts. Perianth longly exserted, oblong-obovate, normally indistinctly 5-plicate above, the mouth slightly contracted, lobed and unequally *spinous-ciliate*, the cilia to 8 cells long. Capsule broadly oval, bright reddish-brown. Spores 9–12 μ, verruculose, brown. ♂ bracts terminal, in 2–3 pairs, erecto-patent, greatly ventricose, longly apiculate; antheridia large, solitary, oval-globose, the pedicel of equal length. *Gemmae vinous-red* at the apex of *erect shoots having erecto-appressed deformed leaves*, also less frequently at the apex of normal stems, cubic, stellate or irregularly angled, *1-celled*.

Hab. Decaying logs and stumps in shaded ground, subalpine.

Distrib. Westmoreland to Aberdeen, very rare.

The erect gemmiferous shoots with the reddish clusters of gemmae at their apices are conspicuous, and as they are frequently present, the plant is not difficult to identify with the lens. The red gemmae-clusters of the more common *S. exsectus* and *S. exsectiformis* do not occur on special shoots. The plant *in situ* has a good deal the appearance of *Nowellia curvifolia*. Under the

microscope it might be mistaken for a *Prionolobus*, but the entire margin of the leaves, which are only ⅓ bilobed, will at once distinguish it from any of our species of that genus, and underleaves are absent. In luxuriant specimens the leaves are stated to show occasionally some irregular crenulations or teeth, but I have not seen this on British specimens. The leaves on the gemmiferous shoots are truncate or slightly bilobed, being erose through gemmae; these shoots are usually purple-brown in colour and are almost without rhizoids. The perianth is frequently brownish below and pale coloured at the apex.

S. minutus is a larger plant, without prostrate stems or numerous rhizoids, and with the leaf-lobes mostly unequal, gemmae usually 2-celled and not on special shoots, etc.

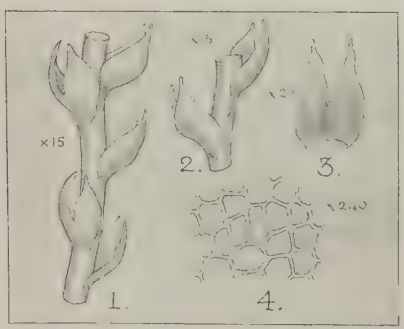
Subgen. Cephaloziopsis (Spruce) Macv.

Jungermannia Subgen. *Lophozia* Sect. *Cephaloziopsis* Spruce, Hep. Amaz. et And. p. 511 (1885).
Cephaloziopsis Gen. Schiffn. in Engl. and Prantl I 3 p. 85 (1893).
Jungermannia Subgen. *Cephaloziopsis* Pears., Hep. Brit. Isles p. 359 (1901).

Plants small, with the habit of *Cephaloziella*, but with the branches lateral, rarely also postical, perianth pluri-plicate or trigonous, in the last case with the third angle antical.

124. Sphenolobus Pearsoni (Spruce) Steph.

Jungermannia Pearsoni Spruce, Jour. Bot. X (1881); Pears., Hep. Brit. Isles p. 359 (1901).
Cephaloziopsis Pearsoni Schiffn. in Engl. and Prantl I 3 p. 85 (1893).
Sphenolobus Pearsoni Steph., Spec. Hep. II p. 163 (1902).
Cephalozia Pearsoni Steph., Spec. Hep. III p. 325 (1908).



1. Stem (antical). 2. Stem (postical). 3. Leaf. 4. Cells.

Dioicous. Small. In *depressed patches, reddish-brown to yellowish-brown*, in shade reddish-green. Stems 5–15 mm long, yellowish-brown, filiform, flexuous, *rigid when dry*, prostrate or with the upper part ascending, *1–3 times furcate*, more rarely simple, the branches *lateral*; rhizoids *scarce*, long and colourless, to near apex of stem. Leaves *small*, distant or subapproximate, of nearly equal size throughout, erecto-patent, the *upper part of the lobes more erect and nearly parallel with the*

stem, the apex *frequently incurved*, transversely inserted, not decurrent, obtusely conduplicate-concave, subquadrate or broadly obcuneate, bilobed *beyond the middle to* $\frac{2}{3}$, the sinus narrow at base and rounded or subacute, lobes equal or subequal, slightly divergent, narrowly triangular-ovate, *acuminate*, the antical margin occasionally with a tooth at base; cells *14-18* μ, rectangular, opaque, the walls rather strongly and *equally thickened*, trigones therefore absent, apical cell of lobes acute and hyaline; cuticle minutely verruculose. Underleaves small, subulate, mostly confined to near apex of stem, but frequently absent. ♂ bracts terminal in *ovate capitate heads*, *bracts much larger than the leaves*, erect, closely imbricate, ventricose, the base of antical margin frequently with a tooth; antheridia solitary, roundish-oval.

Hab. Boulders in shady ground and on rather wet rocks, subalpine, ascending to 2000 ft. alt.

Distrib. Wales to Argyll, very rare.

The reddish-yellow colour, the stem rigid when dry, the capitate androecia, together with the small size of the plant, make it as a rule easily recognised in the field. Under the microscope the furcate branching is very distinct, also the angle which the leaves make with the stem. It might be overlooked for *Cephaloziella byssacea*, but is of a brighter colour than that species ever assumes, and the leaves are more regularly and equally placed on the stem; on closer examination they cannot be confused, the furcate branching alone being sufficient to distinguish the present plant. *Marsupella Stableri*, which has a somewhat similar colour, is smaller and with more appressed leaves, branching different, underleaves absent, etc.

The underleaves are rudimentary, rarely being well developed.

The ♂ plant is very common and the bracts are conspicuous, both in the terminal ovate heads and interruptedly along the stem; the antical tooth is occasionally developed into a triangular-subulate lobe. The ♀ plant has not yet been found.

This plant differs considerably from the other species of the genus and might perhaps be best placed in *Cephaloziopsis* as a separate genus.

Subgen. Tritomaria (Schiffn.) K. Müll.

Tritomaria Gen. Schiffn., Krit. Bemerk. u. eur. Leb. Ser. V p. 12 (footnote) in Beilage Ber. nat. Ver. Innsbruck 31 (1908).

Tritomaria K. Müll., Rabh. Krypt. Fl. I p. 589 (1910).

Leaves less distinctly conduplicate-concave, 2–3-lobed with unequal lobes, or 3-lobed with equal lobes.

125. Sphenolobus politus (Nees) Steph.

Jungermannia polita Nees, Eur. Leb. II p. 145 (1836).
Diplophyllum politum Dum., Hep. Eur. p. 50 (1874).
Sphenolobus politus Steph., Spec. Hep. II p. 169 (1902).

1. Stem. 2. Leaf. 3. Cells.

Dioicous. In scattered stems or loosely tufted among mosses, reddish-brown to yellowish-brown, occasionally yellowish-green. Stems 1–3 cm long, thick, rigid, brown above *dark purple underneath, decumbent and arcuate below*, ascending or erect above, simple or furcate, innovating from below the ♀ inflorescence; rhizoids somewhat numerous below, scarce or almost absent in the upper parts, vinous-red at the base, otherwise colourless. Leaves *soft and shining*, somewhat distant to imbricate, patent to almost squarrose from an *erect sheathing base*, transversely inserted, not decurrent, obtusely conduplicate-concave, *subquadrate*, *truncate 3-lobed*, *plicate-undulate near the apex*, *lobes short*, *obtuse*, sometimes hardly apparent, the sinus plicate and gibbose, especially in the leaves when approaching the perianth; cells large, 32–45 μ, rounded-polygonal, trigones usually large but variable; cuticle nearly smooth. *Underleaves absent.* Involucral bracts erect, resembling the leaves but more plicate and 3–5-lobed. Perianth nearly cylindrical, obtusely plicate at the apex, the mouth contracted, *sinuate-entire*. ♂ bracts terminal in several pairs, resembling the leaves, erecto-patent, imbricate, concave, saccate at base; antheridia 2, oval-globose, shortly pedicellate. Gemmae (teste Kaalaas) reddish-brown, on the apex of the leaf-lobes, three- to many-angled, often stellate.

var. medelpadicus Arnell, Lebermoosstud. in Nörd. Norv. p. 27 (1892).

Jungermannia medelpadica Arnell, Rev. Bryol. p. 12 (1891).
Sphenolobus medelpadicus Steph., Spec. Hep. II p. 169 (1902).

Yellowish-green to yellowish-brown. *Leaf-cells with large trigones, the cell-cavity stellate.* Otherwise as in the type.

Hab. Side of streams and in wet places from 1900–3100 ft. alt., alpine.

DISTRIB. Dumbarton to Perthshire, rare. Var. *medelpadicus*, Cam Creag, Killin *(H. H. Knight)*.

This species varies in colour, habit and cell structure. The transverse, sheathing, obtusely 3-lobed leaves, together with the absence of underleaves, render it easily known from our other alpine species. The only plant which I have found to resemble it at all in the field is *Lophozia quinquedentata*, which is of about the same size and frequently of a similar colour, and often found in wet ground in the same localities; the *Lophozia* can be at once separated with the lens by its pointed leaf-lobes and the larger and greatly arched postical margin of leaf.

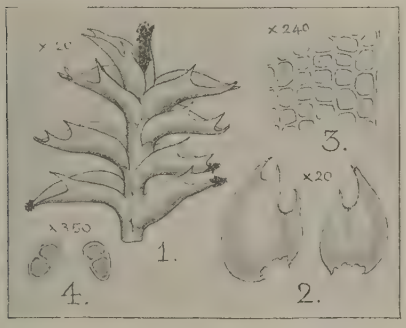
Only the lower half of the leaf may be concave, or the leaves may be concave throughout, especially near the apex of the stem; they are sometimes vinous-red at the base. The lobes are here and there occasionally acute or subacute, but the much greater majority are obtuse or rounded-obtuse. The sinus between the two antical lobes is usually deeper and more plicate than the other; and the folds of the sinus can be frequently seen extending down the leaf. Both involucral bracts may be 3-lobed, or one be distinctly 3-lobed, and the other shallowly 4–5-lobed.

♂ plants are frequent with us, perianths less so, while fruit has not been found in Britain. Gemmae are very rare, and appear only to have been seen by Kaalaas in Norway. He mentions that the leaves on which gemmae occur have the lobes long and thin, sharply pointed and often toothed at the margins.

The var. *medelpadicus* is distinct in its stellate leaf-cells, but forms which are intermediate with the type have been found. Arnell originally described it as a species, but later considered it only as a form of *S. politus*.

126. Sphenolobus exsectus (Breidl.) Steph.

Jungermannia exsecta Schmid., Icon. Pl. ed. 2 p. 241 (1797)?
Lophozia exsecta Dum., Rec. d'obs. p. 17 (1835)?; Boulay Musc. de la France II p. 91 (1904).
Jungermannia exsecta Breidl., Leb. Steierm. p. 320 (1893).
Diplophyllum exsectum Warnstf., Krypt. Fl. Mark Brand. p. 160 (1902).
Sphenolobus exsectus Steph., Spec. Hep. II p. 170 (1902).



1. Stem. 2. Leaves. 3. Cells. 4. Gemmae.

Dioicous. Small. In small compact yellow-green to light brown patches, or scattered among mosses. Stems 5–20 mm long, green above, brown to nearly black underneath, ascending, more or less branched, innovating from below the ♀ inflorescence; rhizoids numerous, long, colourless to fuscous. Leaves imbricate, on the sterile stems frequently distant, somewhat antically secund, the

lower half erecto-patent, the upper half patulous to almost squarrose, transversely inserted, not decurrent, obtusely conduplicate-concave, obliquely ovate or ovate-lanceolate, *unequally and shortly bilobed*, *postical margin large and strongly arched*, antical margin much shorter and less arched, the antical lobe broadly subulate and *almost reduced to a tooth*, postical lobe large, ovate, acute, *frequently bidentate* with a lunate sinus, the margins of lobes entire; cells *10–17 μ*, rounded-polygonal, the walls almost equally thickened. Underleaves absent. Involucral bracts larger than the leaves, erecto-patent, quadrate-rotund, 3–5-lobed, lobes acute to acuminate, entire or dentate. Perianth cylindrical-obovate, plicate at the apex, the mouth unequally spinous-ciliate and spinous-dentate. Capsule ovate. Spores 9–12 μ, papillose, dark brown. ♂ bracts in few pairs, imbricate, saccate at base, the antical lobe incurved; antheridia 1–2. *Gemmae in reddish to yellowish clusters* at the apex of the leaf-lobes, *12–17 μ by 9–11 μ*, *elliptical*, 2-celled.

HAB. Decaying logs and on moss-covered rocks in shady ground, subalpine.

DISTRIB. Wales to West Inverness, rare; Ireland?

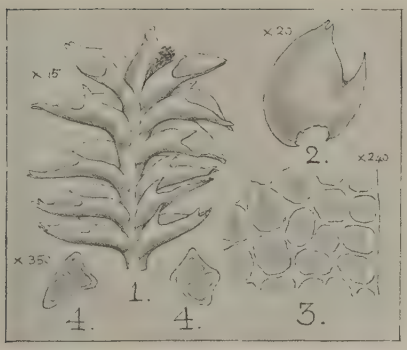
Can hardly be mistaken for any other species except the following, the toothlike antical lobe and the red clusters of gemmae not being found together in our other plants. Gemmae are almost always present and are conspicuous, and they are not confined to the uppermost leaves; they usually form the readiest means of distinguishing either of the two plants when in mixture, or if occurring in small quantity. The cell-walls vary considerably in thickness. In both plants the cells towards the apex of the gemmiferous leaves are elongated, and must not be used in comparative measurements.

The subinvolucral leaves and frequently the involucral bracts have much resemblance in shape, though smaller, to the stem leaves of *Lophozia quinquedentata*.

This species has so far only been found in the western side of the country and in shady ground. *S. exsectiformis*, on the other hand, is widely distributed, both in exposed and shady places.

127. Sphenolobus exsectiformis (Breidl.) Steph.

Jungermannia exsecta Hook., Brit. Jung. *pl.* 19 (1812).
Jungermannia exsectiformis Breidl., Leb. Steierm. p. 321 (1893).
Diplophyllum exsectiforme Warnstf., Krypt. Fl. Mark Brand. p. 161 (1902).
Sphenolobus exsectiformis Steph., Spec. Hep. II p. 170 (1902).
Lophozia exsectiformis Boulay, Musc. de la France II p. 92 (1904)



1. Stem. 2. Leaf. 3. Cells. 4. Gemmae.

Dioicous. Resembling *S. exsectus*, but quite distinct in the leaf cells and gemmae. *Leaf cells about twice as large*, 22–24 μ; cell-walls generally less uniformly thickened, the trigones being larger, the cell-cavity usually more rounded, and at the base more elongated. *Gemmae about twice as large*, 17–26 μ long by 14–20 μ broad, irregularly and obtusely 3–4-*angled*, more rarely pyriform.

Hab. Decaying logs and stumps, and on peaty and sandy banks, subalpine.

Distrib. N. to Shetland, uncommon; Ireland.

There is no difficulty in separating this from *S. exsectus*; they are doubtless both good species. Besides the characters given above, there is possibly also some difference in the involucral bracts, but I have seen too few specimens of *S. exsectus* with bracts to form an opinion. As far as I have seen in *S. exsectiformis*, the margins of the bracts as well as of the lobes are frequently dentate, while in the other the margins are entire, and one or more of the lobes are only denticulate.

The dimensions of the cells are the average taken from the middle of the leaves without gemmae; in both this and the previous plant there are generally to be seen one or two cells considerably larger than the average. The cells at base of leaf in both are much larger.

XXX. ACROBOLBUS Nees

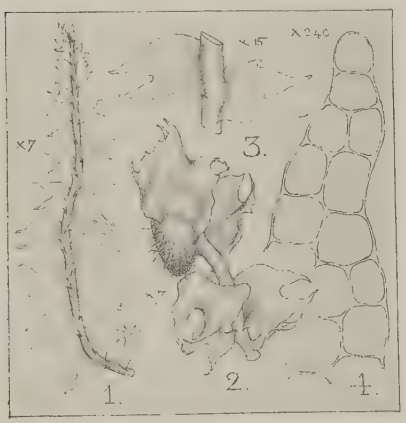
Acrobolbus Nees in G. L. N. Syn. Hep. p. 5 (1844).
Gymnanthe Tayl. in G. L. N. Syn. Hep. p. 192 (1844).

Stems prostrate, with rhizoids, simple or slightly branched. Leaves succubous, *bilobed* with unequal lobes, *erecto-connivent near the inflorescence*. Underleaves absent or minute. Inflorescence dioicous. ♀ bracts large, crispate, more or less armed. *Marsupium terminal*, with rhizoids. Perianth wanting. Calyptra adnate with the inner wall of the marsupium.

The archegonia, surrounded by minute leaves, are situated at the apex of the stem. On fertilization the ventral tissue of the stem enlarges and grows downwards at right angles to the stem, having rhizoids towards the base. The bases of the involucral bracts become concrete with the growing tissue, and with it form a sac, inside which at the base the foot of the sporogonium penetrates. The calyptra is adnate to this sac for its whole length except at the apex which is free and bears the sterile archegonia.

128. Acrobolbus Wilsonii (Tayl.) Nees

Jungermannia Wilsonii Tayl. MS.
Acrobolbus Wilsonii Nees, G. L. N. Syn. Hep. p. 5 (1844).
Gymnanthe Wilsonii Nees, G. L. N. Syn. Hep. p. 192 (1844).



1. Sterile stem. 2. Fertile do. 3. Leaves. 4. Cells.

Dioicous. *In scattered stems creeping over mosses, pale yellow-green* in colour. Stems to 2 cm long, fragile, flexuose, more or less branched, the branches proceeding from the postical angle of the leaves, innovating from below the ♀ inflorescence; rhizoids long and colourless, scattered, on the fertile stems numerous. Leaves very obliquely inserted, on the sterile stems distant, *horizontal or patent*, slightly convex with the upper half frequently somewhat reflexed, on the fertile stems subimbricate, larger, *erecto-secund*; *oblong-obovate*, *unsymmetrical*, the antical margin nearly straight, shortly decurrent, *the postical margin arched*, especially in the lower third, the base somewhat narrowed, one or both margins occasionally with a tooth at middle, $\frac{1}{3}$ bilobed, occasionally 3-lobed, sinus lunate at base, *lobes acuminate*, unequal, the postical generally the larger; cells 28–35 μ, of nearly equal size, rounded-hexagonal, with several chlorophyll granules, walls thin, trigones minute. Underleaves *minute*, scarce, lanceolate to ovate, sometimes bidentate, or absent. Involucral bracts much larger than the leaves, amplexicaul, undulate, crispate, cordate, ventricose at base, the margins dentate to spinous-ciliate, $\frac{1}{3}$ bilobed, sinus gibbose, lobes acuminate. Marsupium obovate-globose, at right angles to the stem. Capsule oval,

dark brown, the pedicel stout. Spores minutely granular, reddish-brown. Elaters bispiral.

HAB. On mosses on moist rocks and stems of trees in very shaded ground.

DISTRIB. West Inverness; West of Ireland. Very rare. Fr. Nov.

This very rare western species has only been found in our most sheltered places, near the Atlantic coast. It is a most difficult plant to detect in the field although of considerable size; this is owing to its scattered stems being of the same colour as the mosses to which it is attached.

The asymmetrical leaves with acuminate lobes do not resemble those of any of our other species except occasionally *Lophocolea* and *Geocalyx graveolens*. The large underleaves in the former are readily distinguished in the field with a lens, and the underleaves of the latter can at least be easily seen under the microscope. *Lophozia excisa* might perhaps be confused with *Acrobolbus*, but the two species grow in quite different kinds of habitat, the *Lophozia* preferring rather dry banks, its paroicous inflorescence is almost invariably present, and the very different perianths are common.

XXXI. ANASTREPTA (Lindb.) Schiffn.

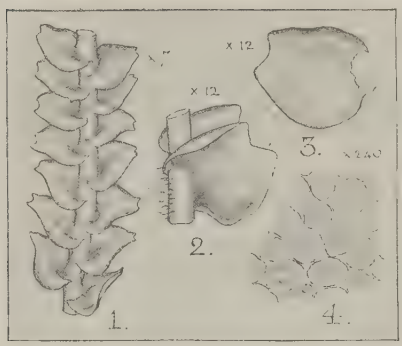
Jungermannia Sect. *Anastrepta* Lindb., Bot. Notis. (1889).
Anastrepta Schiffn. in Engl. and Prantl I 3 p. 85 (1893).

Plants tall but slender with erect stems having few rhizoids except in the lower part, simple or sparingly branched, branches proceeding from the postical angle of the leaves, innovating from below the ♀ inflorescence. Leaves alternate, succubous, *very obliquely inserted but semi-amplexicaul, shortly bilobed, the postical margin broadly recurved*. Cells *small* with thickened angles. Underleaves none or small. Inflorescence dioicous. Bracts irregularly lobed, bracteole lobed or lacerate. Perianth oblong, plicate above, contracted at the sub-entire or setulose mouth. Male bracts saccate, with a tooth at the antical base. Antheridia 1–2.

This genus has the habit of *Plagiochila* and differs from *Sphenolobus* and *Lophozia* in its insertion of leaf. Both margins have a wide insertion across the stem and are semi-amplexicaul, but the leaf is very obliquely placed on the stem.

129. Anastrepta orcadensis (Hook.) Schiffn.

Jungermannia orcadensis Hook., Brit. Jung. *pl.* 71 (1814).
Mesophylla orcadensis Dum., Hep. Eur. p. 130 (1874).
Anastrepta orcadensis Schiffn. in Engl. and Prantl I 3 p. 85 (1893).



1. Stem. 2, 3. Leaves. 4. Cells.

Dioicous. In *tall, erect, reddish-brown to fuscous-brown* or green loose tufts. Stems 4–7 cm long, or more, brown, erect, *commonly simple*, but sometimes slightly branched; innovating from below the ♀ inflorescence; rhizoids short, somewhat numerous to near apex of stem. Leaves imbricate, slightly antically secund, erecto-patent, the apex generally patulous or squarrose, *obliquely cordate-ovate*, concave at base, otherwise convex or nearly flat, obliquely inserted, the antical margin decurrent and *slightly reflexed*, with occasionally a tooth at base, *postical margin broadly reflexed*, the *apex narrow, emarginate*, sinus shallow, broad, lobes broadly triangular, slightly unequal, obtuse or acute; cells small, 16–21 μ, roundish-oblong, the trigones rather large. Underleaves absent or small and subulate and fugacious. Outer involucral bract 2- to many-lobed, the lobes narrow, acute, inner bract oblong, irregularly and acutely lobed; bracteole oblong, irregularly inciso-lobate. Perianth longly exserted, oblong-clavate, plicate at the apex, the mouth contracted, shortly ciliolate and dentate, capsule oblong, the wall with five layers of cells. Spores 10 μ, reddish-brown, finely verruculose. Elaters 8 μ thick, reddish-brown, bispiral. ♂ bracts at the end or middle of the stem, in 3–5 pairs, *smaller than the leaves*, saccate at base, shortly and obtusely bidentate, the antical margin with a tooth at base; antheridia 1–2, shortly pedicellate. Gemmae in reddish-purple clusters at the apex of the leaf-lobes, irregularly triangular or oblong, 2-celled.

Hab. Steep grassy banks, among rocks and rocky ground, subalpine and alpine, ascending to 3700 ft. alt.

Distrib. Wales to Orkney, frequent in the Highlands, rare elsewhere; South-west and west of Ireland.

This very distinct plant cannot be mistaken, the tall erect stems with the reflexed margins of the shortly bilobed leaves not being seen elsewhere. ♂ and ♀ plants occur in Britain, but are uncommon. Perianths have been found in Norway by Herr C. Jörgensen, and more recently by Velenovsky in Bohemia where fruit has also been found. Jörgensen describes the perianth as compressed from the side, this being another point of resemblance with *Plagiochila*; but Müller in describing the fertile perianths from Bohemia in *Krypt Fl.* I. p. 752 could not find any lateral compression, but describes them as obtusely 4-angled

above and plicate at the apex. The description of the capsule, etc., is taken from him. Gemmae are common and vary greatly in shape. The walls of the leaf-cells vary much in thickness; in exposed positions the cells are frequently guttulate.

This species is very frequently found in mixture with *Bazzania tricrenata*, and might be sometimes overlooked on this account, as the plants are a good deal like each other to the naked eye.

Schiffner in his *Hep. Eur. Exs.* Nos. 214–221 gives several forms of this species depending on the situation. Two of them are commonly seen in Britain, viz., *f. attenuata* Nees, a reddish-brown slender plant with rather small imbricate leaves, which grows in exposed sunny places; and *f. elongata*, a larger green plant of moist shady ground.

XXXII. PLAGIOCHILA Dum.

Martinellia Sect. b. S. F. Gray, Nat. Arr. Brit. Pl. 1 p. 692 (1821).
Radula Sect. 3. *Plagiochila* Dum., Syll. Jung. p. 42 (1831).
Plagiochila Dum., Rec. d'obs. p. 14 (1835).

Plants usually large, rarely small. Stem dark brown, seldom pale, ascending or erect, *almost entirely without rhizoids, arising from a creeping, densely radicellose and nearly leafless rhizome-like stem.* Branches proceeding from the postical angle of the leaves. Leaves succubous, decurrent on both sides, *antical margin reflexed, nearly straight,* postical margin *arcuate,* commonly *dentate or spinous-dentate.* Underleaves normally absent, but sometimes present, small. Inflorescence dioicous. ♀ bracts terminal on the stem or branches, free, resembling the stem leaves but often broader and more dentate. Perianth campanulate to cylindrical, *laterally compresssed,* with a dorsal and sometimes a ventral wing, gibbose in the middle, *the mouth wide, truncate* or rotundate and dentate or ciliate. Calyptra free. Capsule oval-globose, usually shortly pedicellate, the walls of several layers of cells. Elaters bispiral. Androecium spicate, terminal or median; bracts small, closely imbricated, saccate at base; antheridia 1–10, commonly 2.

When examining specimens of this genus, leaves from the main stem must be chosen; branch-leaves usually differ considerably from those of the stem, and those of flagelliferous shoots deviate greatly.

The leaf must always be detached from the stem in order to know its form. It is unfortunate that several of our species have been described of which only a few stems have been found. In this genus the leaves vary greatly, and it is only by the examination of a considerable amount of material that the character of a species can be known with certainty. One cannot spend much time working at *P. spinulosa* and *P. punctata* forms where they are abundant on our western coast, without meeting some which seem to be distinct from either, but close examination in the field nearly always produces other forms connecting them with undoubted forms of the common plant.

The cell-structure of *P. spinulosa* and *P. punctata* varies greatly. In both, the cell cavities may be markedly stellate, though less frequently so in *P. spinulosa*. On the other hand, there are minute forms of *P. punctata* with the cell-walls almost equally thickened. Both species can have almost entire leaf-margins.

1 { Antical margin of leaf strongly decurrent 2
  { Antical margin slightly or not decurrent 4

2 { Leaves ciliate-dentate, dentate, or occasionally entire, trigones small ..... *130. asplenioides*
  { Leaves spinous-dentate, the apical teeth usually the longest, trigones large... 3

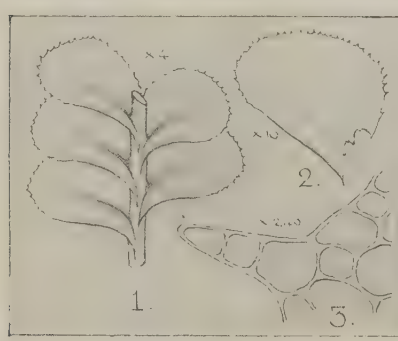
3 { Apex of leaf rounded or truncate, with 2–3 teeth ; postical margin with narrow spinous teeth ..... *131. spinulosa*
  { Apex truncate or rounded-truncate, with 4–6 teeth ; postical margin with large and coarse, broadly triangular teeth ..... *132. ambagiosa*

4 { Leaves horizontal, oblong-quadrate, emarginate, trigones small ..... *135. Stableri*
  { Leaves erecto-patent to patent, the apex entire, bidentate or spinulose, trigones large 5

5 { Leaves oblong-cuneate, $\frac{1}{3}$ bidentate, teeth acuminate ; blackish when dry ..... *134. tridenticulata*
  { Leaves more or less rotundate ; green or brown when dry..... *133. punctata*

130. Plagiochila asplenioides (L.) Dum.

Jungermannia asplenioides L., Sp. Pl. p. 1131 (1753).
Plagiochila asplenioides Dum., Rec. d'obs. p. 14 (1835).



1. Stem. 2. Leaf. 3. Cells.

Dioicous. In rather dense and nearly erect tufts or extended loose patches, green to dark green in colour. Stems 4–6 cm long, erect or ascending, branched, with also several descending nearly leafless branches, innovating from below the perianth ; rhizoids colourless, almost absent on the ascending stem. Leaves small and distant below, larger and imbricate or approximate above, erecto-patent to patent or almost horizontal, frequently much deflexed, *rotund-ovate, almost the whole margin* more or less dentate to ciliate-dentate, antical margin strongly reflexed and *much decurrent*, the postical margin broadly recurved and shortly decurrent; cells 24–34 μ, *walls slightly and almost equally thickened*, trigones being absent or small. Underleaves small, subulate or bifid, or absent. Involucral bracts

rather larger than the leaves, irregularly spinous-dentate. Perianth *longly exserted, obconic-oblong*, the mouth truncate, irregularly dentate-ciliate. Capsule cylindrical-oval, purple-brown, pedicel 1·5–2 cm long. Spores 12–16 μ, reddish-brown, nearly smooth. Elaters purple. Androecium narrowly ovate, terminal, bracts in 4–10 pairs, smaller than the leaves, closely imbricate, erect, concave, ventricose at base, oblong with the antical margin broadly inflated at base, the whole margin entire or denticulate at apex; antheridia generally in pairs, broadly oval, on a pedicel of nearly equal length.

var. **minor** Lindenb., Spec. Hep. p. 111 (1839).

Plagiochila Dillenii Tayl., Journ. Bot. p. 261 (1846).

In dense, usually dark green tufts. Stems 2–3 cm long; leaves imbricate, strongly convex, margin of lower leaves entire, of the upper leaves closely dentate.

Forma **laxa** Matouschek in Verh. d. Nat. Ver. in Brümm. 39 p. 25 (1900).

Tufts lax. Stems more branched, the branches with somewhat distant, mostly entire and less convex leaves. Leaves on the ♀ stems frequently entire except near the perianth.

var. **devexa** Carr., Brit. Hep. p. 56 (1875).

In dense, pale olive-yellow tufts. Stems 3·5–5 cm long, subcircinate, two or three times innovant-furcate; leaves deltoid-rotund, secund, erect, closely imbricated, the antical margin straight, strongly recurved, entire, postical margin projecting backward so as to form a crest with the opposite leaves; perianth oblong, short, scarcely exceeding the involucral bracts, the mouth densely ciliate.

var. **humilis** Lindenb., Spec. Hep. p. 111 (1839)

In small, erect or ascending, yellowish-green tufts, generally in sandy ground. Stems 1–2 cm long, with numerous stolons; leaves imbricate, convex, entire or slightly dentate.

Forma **laxa** Schiffn., Krit. Bemerk. in Lotos p. 41 (1908).

Jungermannia asplenioides δ *heterophylla* Nees, Eur. Leb. I p. 161 (1833).

In loose, flat, green patches in shady ground. Stems prostrate or ascending, with numerous stolons; leaves less imbricate, slightly convex, quite entire or nearly so, somtimes emarginate at the apex.

var. **major** Nees, Syn. Hep. p. 49 (1844).

In tall, erect, loose or compact, pale green tufts. Stems 8–10 cm

long, stout, sparingly branched; leaves large, imbricate, nearly horizontal, dentate.

Forma **subintegerrima** Schiffn., loc. cit. p. 42.

"*Foliis subintegerrimis subrepandis saepe apice oblique emarginatis.*" Lindenb. loc. cit.

Leaves subentire.

HAB. Rocks, banks, tree stems, ascending to 4000 ft. alt.

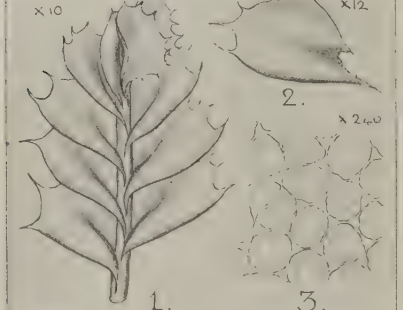
DISTRIB. N. to Shetland, very common; Ireland. Fr. April–June, Sept.

One of the commonest species and very variable. The entire-leaved forms are frequently confused by beginners with other species, but in the great majority of cases the present plant can be distinguished from them by its rhizome-like primary stems, the reflexed and more decurrent antical margin, and by the presence of a few scattered teeth which will nearly always be found on some of the leaves; the small subulate underleaves, which will frequently be found here and there towards the apex of the stems, will assist, as will also the almost equally thickened cell-walls of the leaf. The frequently decurved apex of stem is also a feature to be borne in mind.

The varieties and forms are here arranged according to the method adopted by Schiffner in *Krit. Bemerk*, in *Lotos* p. 37, 1908, as far as I have seen them to occur in our islands. It has been generally acknowledged that they pass into one another, but I am not convinced that this is the case with the var. *major*. At least, it is much the most distinct form, and seldom gives rise to any difficulty in recognising it. I have not seen an authentic specimen of Carrington's var. *devexa*; the description is taken from his *British Hepaticae*.

131. Plagiochila spinulosa (Dicks.) Dum.

Jungermannia spinulosa Dicks., Plant. Crypt. Fasc. 2 p. 14 (1790).
Plagiochila spinulosa Dum., Rec. d'obs. p. 15 (1835).



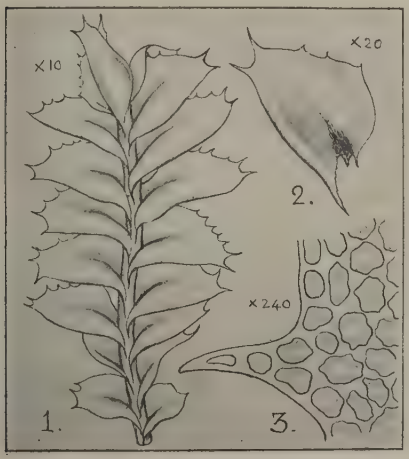
1. Stem. 2. Leaf. 3. Cells.

Dioicous. In extended, erect, rather dense or loose tufts or scattered among mosses, pale yellow-green to reddish-brown in colour. Stems *3–12* cm long, rigid, *simple* or more usually sparingly branched, sometimes flagelliferous, innovating from below the ♂ and ♀ inflorescence; rhizoids colourless, very scarce. Leaves approximate, *erecto-patent*, seldom horizontal, *oblong-ovate*, antical margin entire, slightly arched, *longly decurrent*, reflexed, the

postical margin strongly arched and broadly recurved, with several spinous teeth; cells 21–28 μ, trigones large, the cell-cavity rarely stellate. Underleaves small, broadly triangular, subulate or bifid, sometimes absent. Involucral bracts rather broader than the leaves and with the postical margin more spinous-ciliate especially towards the base. Perianth *urceolate*, mouth truncate, irregularly spinous-ciliate. ♂ plant smaller and more branched; androecium ovate-lanceolate, terminal or median, bracts in 4–5 pairs, closely imbricate with the apex patulous, concave, ventricose at base, the antical margin incurved at base and with a tooth; antheridia usually 1, oval-globose, on a pedicel of almost equal length.

var. killarniensis (Pears.) Macv.

Plagiochila killarniensis Pears., Journ. Bot. p. 281, *pl.* 473 (1905); Steph., Hedwigia 45, p. 214 (1906); K. Müll., Krypt. Fl. I p. 769 (1911).



1. Stem. 2. Leaf. 3. Cells.

Sterile. In olive-green to brown tufts among mosses. Stems 1·5–2·5 cm long, brown, rigid, intricately branched, the branches horizontal; rhizoids colourless, rather numerous on the lower part of the stem, scarce to absent above. Leaves imbricate, *horizontal*, asymmetrical, broadly oblong-ovate *with the apex narrow*, the antical margin entire, nearly straight, *longly decurrent*, slightly reflexed, the postical margin *broadly expanded*, and strongly arched above the base, with 2–3 spinous teeth, the teeth 2 cells long, *the apex truncate or lunate* with two slightly divergent spinous teeth, each 3 cells long; cells 21–29 μ, trigones large to very large, the cell-cavity *frequently stellate*.

var. inermis Carr., Brit. Hep. p. 60 (1875).

In rather compact tufts. Stems 1·5–2·5 cm long. Leaves *nearly horizontal* on the main stem, on the branches suberect with the

upper half frequently squarrose, obliquely ovate, the postical margin also entire or seldom with 1–2 teeth, *the apex emarginate* with two acute or subacute teeth.

HAB. Rocks, rocky banks and tree stems in moist shady ground, chiefly in the west; subalpine, seldom alpine, ascending to 2300 ft. alt.

DISTRIB. N. to Shetland, common to very common in the west, rare elsewhere; Ireland, common. Var. *killarniensis*, Torc Cascade, Killarney, 1905 *(W. H. Pearson)*. Var. *inermis*, Wales, W. of Scotland and Ireland, rare.

Very variable in size, habit, and shape of leaf. Depauperate forms are seen when the plant occurs at its extreme range in longitude, altitude, or rainfall; these have frequently deformed leaves sometimes bilobed or with the margin entire, and generally only slightly decurrent. It is only in the wetter districts, and mainly those of the west coast, that the typical plant is found.

Some of the nearly entire-leaved forms are occasionally confused with similar forms of *P. asplenioides*, but the shape of the leaf is generally different, and the large trigones in *P. spinulosa* are nearly always in evidence. In all forms of the present species the teeth are larger and more irregular in shape than in *P. asplenioides*, and the antical margin is always entire. The two species differ also in shape, etc., of perianth.

Perianths are common in the typical plant; ♂ plants are rare.

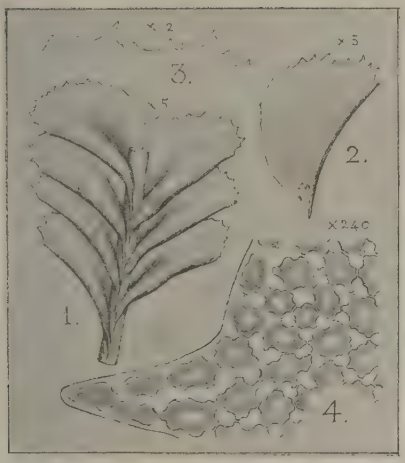
Müller in *Krypt. Fl.* p. 766, describes the var. *inermis* from Husnot's *Hep. Gall. exs.* no. 128, but the plant represented in that number is *Adelanthus decipiens*.

In var. *killarniensis*, the leaves on the lower part of the stem are more symmetrical, and the margin entire or with 1–2 teeth at apex. This plant has only been gathered in small quantity, of which a few stems were kindly sent me by Mr. Pearson. I cannot consider it to be more than a form of *P. spinulosa*. The horizontal leaves and the bispinous apex are seen in other forms, and it has no other character which is not met with in that species. The broad, elongated and thickened cells in the centre of leaf near the base, referred to by Müller, are quite commonly seen in *P. spinulosa*. The other cells vary from being stellate to round. Müller gives *Gott. and Rabh. Hep. Eur. exs.* No. 500, as being *P. killarniensis*, but it is not that plant, though somewhat resembling it; it is intermediate between it and typical *P. spinulosa*, and is a not uncommon form. In form and direction of leaf it is a good deal like the var. *inermis*, but the postical margin is distinctly spinous.

132. Plagiochila ambagiosa Mitt.

Plagiochila ambagiosa Mitt., Trans. Linn. Soc. III p. 195 (1891); Steph., Bull. Herb. Boiss. 5 p. 83 (1897); Pears., Hep. Brit. Isles p. 275. *pl.* 115 (1900); K. Müll., Krypt. Fl. I p. 770 (1911).

Dioicous. In erect loose *reddish-brown* tufts resembling *P. spinulosa*. Stems to 4 cm long, rigid, chestnut-brown, simple or sparingly branched. Leaves ovate-oval to oblong-obovate with a very narrow base, *the apex truncate to rounded-truncate with 4–6 broad, triangular teeth*, imbricate, erecto-patent, the antical margin entire, nearly straight, *longly decurrent*, reflexed, the postical margin



1. Stem. 2. Leaf. 3. Teeth of do. 4. Cells.

strongly arched, *slightly* reflexed, naked on the lower $\frac{1}{3}-\frac{1}{2}$, irregularly dentate above, *the teeth straight*, irregular in size and shape, being mostly *large and coarse*, broadly triangular and acute but *hardly spinous* except in the uppermost leaves; cells 23–30 μ, trigones very large, *the cell-cavity stellate*. Involucral bracts rather larger than the leaves and more spinous-dentate. Perianth with the mouth truncate, regularly and shortly spinous-dentate.

Hab. "Scattered through a palm-broad mass consisting of *Hymenophyllum* matted together with *Pl. spinulosa*, *Pl. punctata*, *Bazzania denudata*, *Adelocolea decipiens*" Mitten *loc. cit.*

Distrib. Bantry, Ireland. *(Miss Hutchins).*

This plant was detected by Mitten in Miss Hutchins' herbarium, and named by him as a new species. Only a small quantity was apparently gathered and it has not been found since.

It is of the same size as *P. spinulosa* but the colour is of a brighter reddish-brown than ever occurs in that plant. It differs also in the broadly truncate apex of leaf which has several teeth, the antical margin straighter, the postical margin less recurved and the teeth much coarser.

The antical margin is strongly decurrent on the leaves at the middle of the stem, less so near the apex of the stem. Stephani gives the leaves as not decurrent and Pearson as shortly decurrent, but both these statements are certainly incorrect. The cell-cavities are usually more or less stellate and sometimes markedly so. The middle basal cells are elongate and thickened as in *P. spinulosa*.

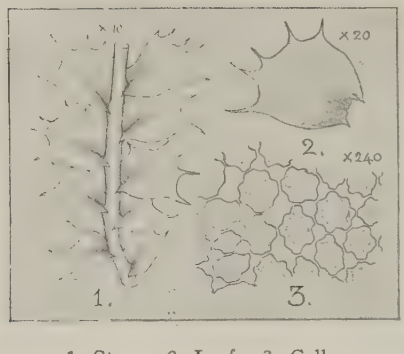
P. ambagiosa has the appearance of a distinct species, but its value is somewhat uncertain on account of the small amount of material available for examination. The description is taken from the original specimen.

133. Plagiochila punctata Tayl.

Plagiochila punctata Tayl., Journ. Bot. p. 371 (1841) et p. 261 (1846).

Plagiochila spinulosa β *punctata* Carr., Trans. Bot. Soc. Ed. 7 p. 445 (1863); Brit. Hep. p. 60 (1875).

Plagiochila spinulosa var. *minuta*, Husn. (*non* Mackay) Hep. Gall. p. 17 (1875).

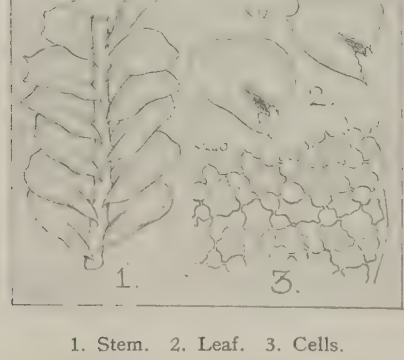


1. Stem. 2. Leaf. 3. Cells.

Dioicous. In *dense* yellow-green tufts. Stems to 2·5 cm long, rigid, flexuous, with divergent branches, frequently flagelliferous; rhizoids colourless, scarce to apex of stem. Leaves small below, larger and imbricate above, in the branches and smaller stems distant, patent to *patent-divergent*, *semi-cordate-ovate* to rotundate, antical margin nearly straight, entire, *hardly or very shortly decurrent*, the postical margin *strongly arched* with a *rounded* base and several long spinous teeth, of which the two at the apex are usually the longest; cells 17–24 μ, *trigones very large*, the cell-cavity frequently stellate. Underleaves subulate to triangular, or absent. Involucral bracts larger and broader than the leaves with the antical margin partly spinous-dentate. Perianth *rotund-obovate* to widely campanulate, *winged*, the wings more or less spinous-dentate, mouth truncate, irregularly and *longly spinous* and spinous-ciliate.

var. **Owenii** (Steph.) Macv.

Plagiochila Owenii Steph., Hedwigia 45, p. 213 (1906); K. Müll., Krypt. Fl. I p. 772 (1911).



1. Stem. 2. Leaf. 3. Cells.

Sterile. In small *yellowish-brown* tufts. Stems to 2 cm long, thin, reddish-brown, rigid, flexuous, *equally leaved*, *simple* or very sparingly branched; rhizoids very scarce, absent above. Leaves not accrescent, small, imbricate, squarrose on the lower half of the stem, patent to erecto-patent above, *quadrate-rotund to rotundate*, on the smaller stems ovate to oblong-ovate, asymmetrical, the antical margin somewhat curved, especially at the base,

reflexed, *shortly* decurrent, entire, the postical margin *strongly arched*, broadly recurved, *sinuate, entire or with a spinous tooth near the middle*, seldom with 2–4 teeth, the apex rounded and entire, seldom with a spinous tooth, frequently emarginate with two spinous teeth on the uppermost leaves; cells 21–28 μ, trigones very large, the *cell-cavity stellate*.

var. **minuta** Bréb., Hep. de la Normandie p. 5 (1840).

Plagiochila spinulosa var. *microphylla* Carr., Trans. Bot. Soc. Ed. 7 p. 446 (1863) ?

Small, in dense compact tufts. Stems 1–2 cm long, erect, much branched. Leaves closely imbricate, caducous, erecto-patent to patent, sometimes squarrose, very variable on the same stem, rotund to *obovate-cuneate*, *the apex frequently emarginate*, margin with 2–6 spinous teeth, sometimes entire except at the emarginate apex.

HAB. Rocks and tree stems in moist, shady ground, almost confined to the west, subalpine.

DISTRIB. Cornwall to Ross, common to very common in the West Highlands, uncommon to rare elsewhere; West of Ireland, very common. Var. *Owenii*, Killarney, 1906 *(S. G. Owen)*.

This species is subject to much variation. It is smaller, more intricately branched and more flagelliferous than most forms of *P. spinulosa*, but is distinguished principally from the latter by the rounder leaves, the postical margin having its base arched and cordate, the leaves very shortly decurrent, more divergent from the stem, the teeth longer and more spinous-ciliate, and the trigones generally larger. Typical forms of the two plants are very distinct and are readily separated, and as such plants are the best developed and normal, the two may be considered as distinct species, but some forms of *P. spinulosa*, which cannot be considered as being depauperate, approach so closely to *P. punctata* that I do not think that they can always be distinguished from one another. This applies to the Atlantic coast where both plants occur in abundance. This was also the opinion of Carrington when studying the plants from the south-west of Ireland, but I look upon them as being considerably more distinct from one another than he apparently did. The two species have also a somewhat different distribution, *P. punctata* being more exclusively a western species with us: it goes slightly over the western watershed into the eastern when the hepatic flora is still in great part of the Atlantic type, but it does not, as does sometimes *P. spinulosa*, occur in the eastern parts of the country. The cells are sometimes larger than the measurements given above. Taylor's original specimen of *Jungermannia punctata* has markedly stellate leaf-cells.

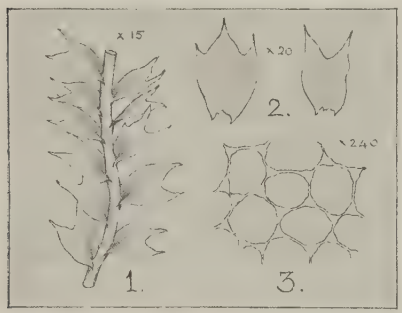
Minute forms of this species have usually retuse or emarginate leaves, which are commonly otherwise entire. They are usually found on dry rocks. A specimen of this form in my possession is named var. *edentula* Carr., but this appears to be a manuscript name. This form is larger than var. *minor* Bréb.

I can only look upon *P. Owenii* as a somewhat abnormal form of *P. punctata*; the form of the leaf, and the entire or nearly entire margin can be seen in forms of the type, and the cell-structure resembles what is frequently seen in that species. I have seen intermediate plants from the same district.

134. Plagiochila tridenticulata Tayl.

Jungermannia spinulosa β *tridenticulata* Hook., Brit. Jung. no. 14 β (1812) ?

Plagiochila tridenticulata Tayl. in G. L. N., Syn. Hep. p. 26 (1844); Carr. Brit. Hep. p. 63 *pl.* 3 f. 10 (1875); Pears., Hep. Brit. Isles p. 280 *pl.* 118 (1900).
Plagiochila exigua Tayl., Trans. Bot. Soc. Ed. 1 p. 179 (1843) et Journ. Bot. p. 264 (1846); Pears., Hep. Brit. Isles p. 282 *pl.* 119 (1900).



1. Stem. 2. Leaves. 3. Cells.

Dioicous. In widely extended, depressed, *olive-green* patches, *nearly black when dry*, or paler coloured and loosely tufted in very shaded or wetter ground. Stems to 2 cm long, filiform, rigid, flexuous, sparingly and longly branched, frequently innovating from below the ♂ inflorescence; rhizoids colourless, very scarce to apex of stem. Leaves *firm*, *distant* to approximate, erecto-patent to patent, *oblong-cuneate*, the base *narrow*, margins *subequally* curved and more or less irregular, the postical *occasionally with a tooth at middle*, the antical very shortly or not decurrent, $\frac{1}{3}$-*bilobed*, seldom 3-lobed, sinus lunate, lobes triangular, acuminate, unequal, the postical being rather the larger; cells 21–25 μ, trigones rather large, but in the more shaded plants small. Underleaves small, subulate to filiform, or absent. ♀ inflorescence unknown. Androecium terminal, oblong-ovate, bracts in 4–5 pairs, closely imbricate, very broad and concave, inciso-dentate at the apex, the teeth 2–4, lanceolate-subulate, the antical margin of bract with an additional tooth; antheridia generally solitary, broadly oval, on a pedicel of nearly equal length.

Hab. Tree stems and rocks in shady ravines on the west coast.

Distrib. Wales to Ross, rare; Ireland.

This is a very distinct species. It is easily distinguished from other species by its nearly black colour when dry and by the leaves, which are longer in proportion to their breadth than in the small forms of *P. punctata* or *P. spinulosa*. Even the pale forms of shady ground have firmer leaves than in the small corresponding forms of the others. Some forms of *P. punctata* occur, in which the leaves, especially of the branches, are bilobed, and occasionally also with a tooth in the middle of the postical margin, but these have always thin, green leaves which are generally not narrowed at base, and they can usually be detected as being innovations; also on other parts of the stem, leaves will be found of various shapes, while in *P. tridenticulata* the leaf-form varies little in shape.

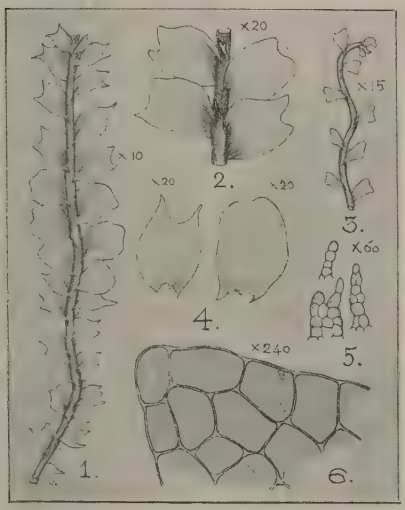
The common occurrence of ♂ inflorescence is a good distinguishing character between this and *P. punctata*, as in the latter it is very rare.

The leaves are very caducous, causing the stem to be here and there naked, but this is also seen to some extent in *P. punctata*.

P. exigua Tayl. is only a form of the present plant when in wet or moist shaded ground. Original specimens of Taylor's shew without any doubt that it is not a distinct species.

135. Plagiochila Stableri Pears.

Plagiochila Stableri Pears., Journ. Bot. p. 241 *pl.* 358 (1896); Hep. Brit. Isles p. 273 *pl.* 112 (1900).
Pedinophyllum Stableri K. Müll., Rabh. Krypt. Fl. I p. 780 (1911).



1. Stem, antical view. 2. Do., postical. 3. Branch. 4. Leaves. 5. Underleaves. 6. Cells.

Sterile. *Small.* In loose depressed, green to brownish green patches. Stems to 12 mm long, pale brown, prostrate below, ascending above, simple or slightly and vaguely branched, occasionally partly denudate; rhizoids rather scarce, but sometimes extending to apex of stem or branches. Leaves contiguous or imbricate on the larger stems, distant on the smaller stems and on the branches, *greatly variable in shape, not or hardly decurrent, oblong-quadrate* to oblong-oval or oblong-obovate, *nearly horizontal* to patent and slightly convex on the larger stems, *frequently cuneate on the branches, the apex entire, retuse, emarginate or emarginate-bilobed*, the lobes usually rounded or obtuse on the larger leaves, but frequently acute on the smaller; cells *24–35* μ, the walls slightly thickened, *trigones small.* Underleaves small, subulate, rarely bifid.

Hab. Moist shady rocks near a waterfall.

Distrib. Rydal Park, Westmoreland, 1877 *(G. Stabler).*

Although only once collected and in small quantity, *P. Stableri* appears to be a distinct species. It has no resemblance to our other species of *Plagiochila*. It is rather more like *Pedinophyllum interruptum*, though much smaller. Stephani, in *Spec. Hep.* II p. 318, suggests that it may be possibly a form of that species, but I hardly think that this can be the case. Müller places it, though with some doubt, in the genus *Pedinophyllum*. The material is insufficient to be certain of the position of the plant. The apex of the stem is occasionally denudate and flagelliferous. There are a few stems of *P. asplenioides* var. *humilis* mixed with the specimen.

XXXIII. PEDINOPHYLLUM Lindb.

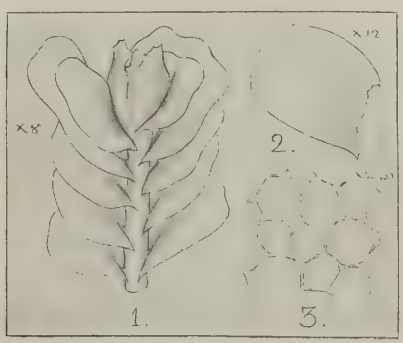
Pedinophyllum Lindb., Bot. Notis. p. 156 (1874); Hep. in Hib. lect. p. 504 (1875).

Monoicous. Plant with the habit of *Chiloscyphus*. *Rhizoma-like stem absent. Stems creeping, with rhizoids, forming depressed patches.* Leaves oblong-quadrate, entire or retuse, nearly flat, hardly decurrent. Underleaves present. ♀ inflorescence terminal on the branches. Perianth compressed as in *Plagiochila*.

This genus comprises only one species, so far as known at present. It has the laterally compressed perianth of *Plagiochila*, but as Lindberg and Schiffner have pointed out, it has little else in common with that genus. A rhizomatous base is absent, the stem and branches both being prostrate and producing rhizoids, while in *Plagiochila* there are creeping rhizomes, from which arise the erect and ascending stems which are generally without rhizoids. Another important distinction lies in the inflorescence, this being dioicous in *Plagiochila*, while it is monoicous in the other. The present genus appears to be more nearly related to *Leptoscyphus* and to *Chiloscyphus* than to *Plagiochila*.

136. Pedinophyllum interruptum (Nees) Pears.

Jungermannia interrupta Nees, Eur. Leb. I p. 165 (1833).
Plagiochila interrupta Dum., Rec. d'obs. p. 15 (1835); Carr., Brit. Hep. p. 52 (1875).
Plagiochila pyrenaica β interrupta Lindb., Not. pro F. Fl. Fenn. 13 p. 367 (1874).
Leptoscyphus interruptus Lindb., Musc. Scand. p. 4 (1879).
Pedinophyllum interruptum Pears., Hep. Brit. Isles p. 269 *pl.* 111 (1900).



1. Fertile stem. 2. Leaf. 3. Cells.

Monoicous. In broad, depressed, yellow-green to olive-brown patches on calcareous soil. Stems 1·5–4 cm long, *leafy throughout*, flexuous, *prostrate* with the apex ascending, irregularly branched; rhizoids long, fuscous, rather *numerous* to near apex of stem. Leaves firm, imbricate, subcomplanate, *nearly horizontal*, the terminal ones frequently erecto-connivent, oval-*quadrate*, the apex rounded or retuse,

antical margin hardly decurrent; cells 23–30 μ, opaque, the marginal row nearly quadrangular, trigones minute or none; cuticle smooth. Underleaves minute, usually confined to near the apex of the branches, filiform, simple or divided. Involucral bracts resembling the leaves, but larger, the margins recurved. Perianth shortly exserted, broadly obovate, slightly longer than broad, laterally compressed, the mouth wide, bilabiate, rounded, crenulate to denticulate. Capsule oval, dark brown. Spores 12 μ, reddish-brown, nearly smooth. Androecium terminal or median, bracts in 4–5 pairs, closely imbricate, erect, concave, saccate at base, the antical margin with a small lobe inflated at base; antheridia generally solitary, oval-globose.

var. **pyrenaicum** (Spruce) Kaal., De Dist. Hep. Norv. p. 190 (1893).

Plagiochila pyrenaica Spruce, Trans. Bot. Soc. Ed. 3 p. 200 (1849).

Plagiochila interrupta β pyrenaica Lindb. in Hartm., Skand. Fl. ed. 10 II p. 130 (1871); Carr., Brit. Hep. p. 53 (1875).

Pedinophyllum pyrenaicum Lindb., Hep. in Hib. lect. p. 504 (1875).

Leptoscyphus interruptus β pyrenaicus Lindb., Musc. Scand. p. 4 (1879).

Leaves 2–3-, sometimes 4-dentate at the apex. Mouth of perianth acutely dentate.

Hab. On shaded calcareous rocks.

Distrib. Derby and Yorkshire to Argyll, rare. Fr. May.

Distinguished when sterile from entire-leaved forms of *Plagiochila asplenioides* by its creeping stem with rather numerous rhizoids, the absence of a primary rhizome-like stem, antical margin of leaf only slightly decurrent, and the habit of the plant. The monoicous inflorescence and different shape of perianth, when present, will at once distinguish the plant. It has much the habit of *C. polyanthus*, but sterile specimens of the latter can be known from it by the larger bifid underleaves and the different cell-structure. In the dried plant the chlorophyll granules are collected near the margin of the leaf and give the cells the appearance, under small magnification, of having thick walls.

The var. *pyrenaicum* is noticeable in that many of the leaves are dentate at the apex, and the mouth of the perianth is sharply dentate, but these characters are not constant.

XXXIV. LEPTOSCYPHUS Mitt.

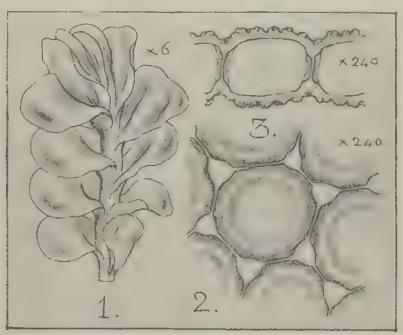
Mylius S. F. Gray, Nat. Arr. Brit. Pl. I p. 693 (1821); Carr., Trans. Bot. Soc. Ed. 10 p. 305 (1870) et Brit. Hep. p. 66 (1875).
Leptoscyphus Mitt., Journ. Bot. p. 358 (1851).
Leioscyphus Mitt. in Hook. Handb. New Zeal. Fl. 2 p. 134 (1855); Steph., Spec. Hep. III p. 13 (1906).
Coleochila Dum., Hep. Eur. p. 105 (1874).

Stem with long rhizoids, simple or sparingly branched, with subfloral innovations. Leaves succubous, alternate or opposite, *entire*, rarely bilobed, subrotund to ovate, cells with thickened walls. *Underleaves always present*, entire or bifid, the margins sometimes armed. Involucral bracts resembling the leaves. Perianth terminal on the main stem, rarely on a branch, inflated below, *laterally compressed above, the mouth truncate and bilabiate*, entire or denticulate. Capsule oval-globose, coriaceous, the wall of several layers of cells. Androecium usually median; antheridia generally single.

1 { Plant minute, to 1 cm long, leaves distant, obcuneate.....*139. cuneifolius*
  { Plant large, leaves round or ovate 2
2 { Leaf-cuticle verrucose; leaves rotundate... .....*137. Taylori*
  { Leaf-cuticle smooth; upper leaves usually ovate.....*138. anomalus*

137. Leptoscyphus Taylori (Hook.) Mitt.

Jungermannia Taylori Hook., Brit. Jung. *pl.* 57 (1813).
Mylia Taylori Gray, Nat. Arr. Brit. Pl. 1 p. 693 (1821).
Leptoscyphus Taylori Mitt., Journ. Bot. p. 358 (1851).
Coleochila Taylori Dum., Hep. Eur. p. 106 (1874).



1. Stem with leaves. 2. Cells. 3. Do., section.

Dioicous. In large, *erect*, yellow-green to *reddish-purple* tufts. Stems 3–8 cm long, stout, flexuous, *erect or ascending*, irregularly branched; rhizoids long and colourless, numerous to apex of stem. Leaves distant below, imbricate above, patent to horizontal, broadly inserted, saccate at base, otherwise *convex, rotund to oblong-rotund*, margin somewhat undulate, the antical margin shortly decurrent; cells 45–58 μ, smaller at the margin,

roundish, prominent, reticulate, *trigones very large*, confluent at the base; *cuticle coarsely verrucose*. Underleaves subulate or filiform, mostly concealed by the rhizoids. Involucral bracts rather larger than the leaves, undulate, erect at base, recurved at apex. Perianth exserted ½ beyond the bracts, oblong, inflated below, *laterally compressed above*, unsymmetrical, verrucose, the mouth narrowed, truncate, *ciliate*, cilia to 6 cells long, the cells verrucose. Capsule oval-globose, dark brown, outer layer of wall with reddish-brown nodular thickenings, inner layer with numerous *complete* semi-annular thickenings along the whole length of valves. Spores 15–18 μ, brown, asperous. Elaters bispiral, reddish-brown. ♂ plant with oblong leaves, androecium terminal, bracts in 4–8 pairs, transverse, suberect, imbricate, the lower half concave and saccate at base; antheridia generally in pairs, oval-globose. Gemmae oblong to oval, reddish-brown or green, on the margins of the upper leaves which thus become frequently erose, or as filiform, occasionally branched lines of cells in disorganised uppermost leaves.

Hab. Peat-mosses, wet peaty banks and rocks, occasionally on tree stems and stumps, subalpine, rarely ascending above 3000 ft. alt.

Distrib. Staffordshire to Shetland, common in many districts; Ireland. Fr. July–Aug.

The cell-structure of leaf with its large cells and trigones is different from any other round-leaved species except some forms of *L. anomalus*, and the coarsely verrucose cuticle will always distinguish it from the latter. In plants of very wet ground the verrucosity may be confined to near the base of the leaves. The colour of *L. Taylori* tends to being purple, while the other is more of a yellowish-brown. Gemmae are not uncommon in this species; the gemmiferous leaves remain rotund; ovate, acute leaves do not occur, but those of the male plant are oblong. There is also a difference in the capsule-wall of the two species. *L. Taylori* forms large erect masses in its most common state, while *L. anomalus* usually grows in thin layers among *Sphagnum*, but the former is not uncommonly seen as a prostrate, creeping plant on bare peat.

The underleaves in both species are concealed by the rhizoids; they are most easily seen near the apex of the stem.

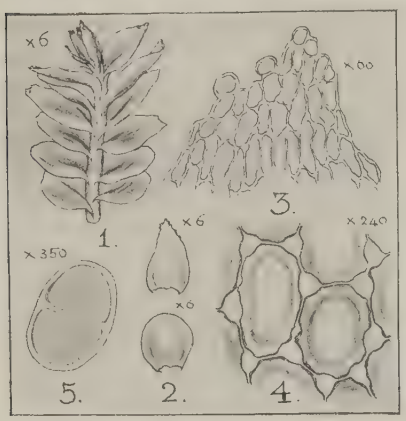
The most distinct form of this species is *f. parvifolia* Schiffn., *Krit. Bemerk.* in *Lotos* p. 5, 1910. It resembles the type, but has much smaller leaves. It is found in erect, compact tufts and is not confined to the male plant.

Müller gives as a generic character, and as one of the marks which are distinctive from *Lophozia*, the large external layer of cells of the pedicel of capsule. In *Leptoscyphus* the external cells are 18–20 in number and twice as large as the inner cells. In *Lophozia*, according to Douin's researches, the cells are apparently much more numerous.

138. Leptoscyphus anomalus (Hook.) Mitt.

Jungermannia anomala Hook., Brit. Jung. *pl.* 34 (1813).
Mylia anomala Gray, Nat. Arr. Brit. Pl. 1 p. 693 (1821).

Jungermannia Taylori β anomala Nees, Eur. Leb. II p. 455 (1836).
Coleochila anomala Dum., Hep. Eur. p. 106 (1874).
Mylia Taylori Subsp. *anomala* Carr., Brit. Hep. p. 68 (1875).



1. Stem. 2. Leaves. 3. Apex of gemmiferous leaf. 4. Cells. 5. Gemma.

Dioicous. Loosely tufted or *creeping among Sphagnum*, rarely in dense tufts, yellow-green to *yellow-brown* in colour. Stems 2–4 cm long, stout, flexuous, *procumbent*, simple or sparingly branched; rhizoids long and colourless, numerous to apex of stem. Leaves imbricate or distant, patent, broadly inserted, *concave*, rotund or oblong-rotund, the antical margin very shortly decurrent, *upper leaves commonly gemmiferous, erose at apex and ovate-lanceolate with the margins incurved;* cells 45–55 μ, roundish, smaller and subquadrate at the margin, trigones very large, *cuticle smooth*; cells in the ovate-lanceolate gemmiferous leaves greatly elongated, especially in the centre of leaf. Underleaves broadly subulate, sometimes bidentate at apex, mostly concealed by the rhizoids. Involucral bracts roundish-ovate, erect at base, recurved at apex. Perianth oblong-oval, *laterally compressed above*, the mouth narrowed, truncate, *crenulate*. Capsule oval-globose, inner layer of wall with *incomplete* semi-annular thickenings on the middle and upper part of valves. Spores asperous. Elaters bispiral. Androecium terminal, bracts in 5–7 pairs, transverse, suberect, imbricate, ovate, concave, saccate at base; antheridia in pairs, globose. *Gemmae in yellow-green clusters* on the upper leaves which are generally *ovate-lanceolate*, or scattered on their margins, oval to oblong-ovate, mostly 2-celled.

Hab. On low-lying moors, occasionally on sand rocks, and stumps, rarely ascending above 2000 ft. alt.

Distrib. N. to Shetland, widely distributed, but generally uncommon; Ireland. Fr. very rare.

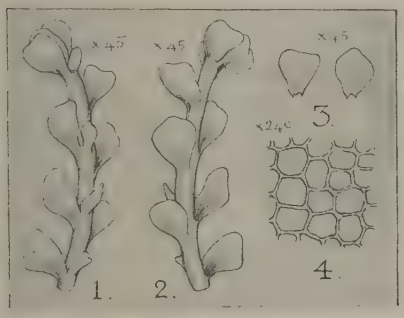
This species was at one time confused with *Jamesoniella Schraderi* and *Aplozia lanceolata*, but at present it seems to be rarely confused with any except *L. Taylori*. The smooth leaf-cuticle will always distinguish it from the

latter; also the ovate gemmiferous leaves with their lengthened cells are not found in that plant; both are readily known from any other species by the very large cells and trigones. The cells lengthen with the elongation of the ovate, acute gemmiferous leaves, all stages between normal and elongated cells being seen. The clusters of gemmae contain filiform lines of cells as in *L. Taylori*. Gemmae are not confined to the ovate leaves, but can be frequently seen scattered on the margin of the uppermost leaves in the round-leaved form.

Schiffner in *Krit. Bemerk.* in *Lotos* p. 61, 1908 gives several forms of the species. These depend on the habitat. The most noticeable is the var. *submersus*, which grows submerged in erect, green tufts, but even this passes into the land plant where not submerged. He considers the round-leaved form as the typical plant.

139. Leptoscyphus cuneifolius (Hook.) Mitt.

Jungermannia cuneifolia Hook., Brit. Jung. *pl.* 64 (1814).
Mylia cuneifolia Gray, Nat. Arr. Brit. Pl. I p. 694 (1821); Spruce, Bull. Soc. Bot. France p. 178 (1889).
Leptoscyphus cuneifolius Mitt., Journ. Bot. p. 358 (1851).
Aplozia cuneifolia Dum., Hep. Eur. p. 55 (1874).
Coleochila cuneifolia Dum., Hep. Eur. p. 106 (1874).
Clasmatocolea cuneifolia Spruce, Hep. Amaz. et And. p. 440 (1885); Pears., Hep. Brit. Isles p. 254 *pl.* 105 (1900).
Leioscyphus cuneifolius Steph., Spec. Hep. III p. 18 (1906).



1. Stem, postical view. 2. Do., antical. 3. Leaves. 4. Cells.

Minute. In small depressed *reddish-brown* patches, frequently *creeping among Frullania Tamarisci or F. germana.* Stems to 1 cm long, filiform, rigid, brittle, flexuous, brown, procumbent, simple or sparingly branched, frequently *partly naked on account of the easily broken off leaves and underleaves;* rhizoids scarce, colourless. Leaves thick, brittle and caducous, *distant*, sometimes approximate at intervals on the stem and at its apex, erecto-patent, almost transversely inserted, slightly concave, the antical margin hardly decurrent, *obcuneate* to subrotund, the base narrow, *apex truncate, rounded or occasionally retuse;* cells 15–22 μ, almost all of equal size, roundish-quadrate, walls reddish-brown, thickened, especially at the angles; cuticle smooth. *Underleaves numerous and distinct*, very variable, erecto-patent to patent, obtusely ovate-triangular, cuneate or subulate, entire or occasionally with a tooth at side, rarely bifid.

Hab. On birch stems and on rocks in very shaded places, near the Atlantic coast, subalpine.

Distrib. Dumbarton to West Inverness, very rare; West of Ireland.

This minute plant cannot be mistaken for any other species. When once known it is easily recognised in the field when growing in patches, these being thicker and of a more rusty colour than in any *Cephaloziella*. Under the lens the peculiar obcuneate leaves are diagnostic; they are not found in any other of our species. When growing in scattered stems among *Frullania* it might be overlooked, but patches of it will probably always occur in the vicinity.

XXXV. LOPHOCOLEA Dum.

Jungermannia sect. *Lophocolea* Dum.; Syll. Jung. p. 59 (1831).
Lophocolea Dum., Rec. d'obs. p. 17 (1835).

Plants usually large, green or *whitish-green*, soft and flaccid. Stems creeping, irregularly branched, the branches proceeding from the postical angle of the leaves; rhizoids colourless, arising from the base of the underleaves. Leaves succubous, *nearly longitudinally inserted*, more or less decurrent antically, *bifid* or truncate, the margin occasionally ciliate or spinous. *Underleaves everywhere present, usually bifid with a tooth at the sides.* ♀ inflorescence terminal on the main stem or branches. Bracts resembling the stem leaves, often more dentate or ciliate. Perianth commonly oblong, *trigono-prismatic*, the keels frequently winged, the wide mouth *trilobate* with the lobes generally bifid and denticulate or ciliate. Calyptra free. Capsule longly pedicellate, ovate, the wall pluristratose. Androecium longly *spicate* at the middle or end of the branches, or below the perianth; bracts with an inflated antical lobule. Antheridia single. Gemmae unicellular.

1 { Upper stem leaves usually entire or emarginate; paroicous *143. heterophylla*
  { Upper stem leaves never entire; monoicous or dioicous 2

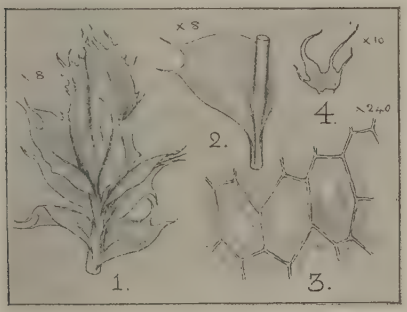
2 { Leaves mostly irregularly dentate; cells 16–21 μ; monoicous ... *144. fragrans*
  { Leaves regularly 2-lobed; cells 25–50 μ 3

3 { Dioicous; rarely with perianth ..... *140. bidentata*
  { Monoicous; usually with perianth 4

4 { Pale yellowish-green; leaf-cells 33–42 μ; angles of perianth not or slightly winged ..... *141. cuspidata*
  { Dark green; cells 40–50 μ; angles of perianth usually highly winged, the wings frequently spinous-dentate ..... *142. alata*

140. Lophocolea bidentata (L.) Dum.

Jungermannia bidentata L., Sp. Pl. 2 p. 1598 (1762).
Lophocolea bidentata Dum., Rec. d'obs. p. 17 (1835).
Lophocolea lateralis Dum., Hep. Eur. p. 84 (1874).



1. Fertile stem. 2. Leaf. 3. Cells. 4. Underleaf.

Dioicous. In pale green or whitish-green loose patches or scattered among mosses. Stems 2–4 cm long, procumbent, sparingly branched; rhizoids scarce, almost absent above. Leaves subimbricate, patent-divergent, *rhomboid*-ovate, asymmetrical, $\frac{1}{3}-\frac{1}{4}$ bilobed, the antical margin slightly curved and *longly decurrent*, the postical margin rather shorter but more curved, the sinus usually lunate, lobes *lanceolate-acuminate*, frequently divergent, commonly unequal, the antical being the smaller; cells 28–35 μ, hexagonal, walls thin, trigones minute; cuticle smooth. Underleaves patent, divided to below the middle into *two subulate-acuminate lobes with generally a subulate tooth or lobe on both sides.* Involucral bracts larger than the leaves, oblong-oval, $\frac{1}{4}-\frac{1}{5}$ bilobed, the margins recurved, entire or with a tooth, sinus obtuse or acute, the lobes acuminate; bracteole oblong-ligulate, $\frac{1}{3}$ bilobed, one or both margins with a tooth, the lobes lanceolate-acuminate. Perianth terminal on the main stem or on lateral branches, *rarely present*, oblong-triquetrous, the mouth deeply 3-lobed, the lobes broadly triangular-acuminate, the margins *sparingly but coarsely dentate.* Capsule oblong-oval, dark brown, the wall with 3–5 layers of cells. Spores 15–18 μ, pale brown, almost smooth. Elaters 8–10 μ thick, reddish-brown, bispiral. Androecia terminal or median on the stem or branches, spicate, bracts in several pairs, closely imbricate, much smaller than the leaves, unequally and acutely 2–3-lobed, saccate at the base of the antical margin with a small incurved, dentate lobe. Antheridia single.

Hab. Banks and walls and wet grassy places.

Distrib. N. to Shetland, common; Ireland. Fr. very rare.

The leaves have seldom three lobes in the typical plant. The fertile plant is considerably branched. Perianths are rare and fruit is very rare. The teeth

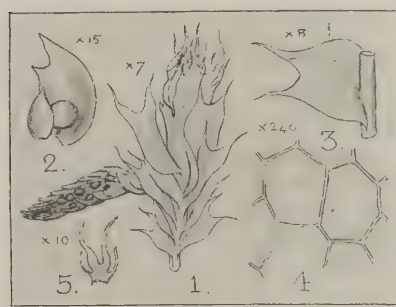
on the margin of the lobes of the mouth of the perianth are sometimes long and acuminate, but they generally end in two single cells.

Forma *latifolia* Nees (*L. latifolia* Nees, Eur. Leb. p. 334, 1836) is a flaccid, elongate form of wet ground, with broader leaves, and with rhizoids almost absent. Schiffner has examined Nees' original specimen. Carrington gives a var. *gracile* of this species in *Trans. Bot. Soc. Ed.* 7 p. 452, 1863. He states that it is not larger than *Cephalozia bicuspidata*, and that it is sometimes found in tufts with *L. cuspidata*. I have not seen an authentic specimen of the variety, but it is probably a state of *L. cuspidata*. Small forms of that species certainly do occur in pure patches, but they are sterile, and it is doubtful if they can be considered as being other than states of the common plant.

Var. *ciliata* (Warnst.), which has not yet been recorded from Britain, has longer points to the leaves and bracts, the leaves frequently 3–4-lobed, the involucral bracts have frequently comparatively long cilia on the margin, and the mouth of perianth has long cilia. This variety is not constant, though very different from the type when well marked. It is a plant of drier ground.

141. Lophocolea cuspidata Limpr.

Lophocolea bidentata β *cuspidata* Nees, Eur. Leb. II p. 327 (1836).
Lophocolea cuspidata Limpr., Krypt. Fl. Schles. p. 303 (1876).



1. Fertile stem. 2. Male bract. 3. Leaf. 4. Cells. 5. Underleaf.

Monoicous. In pale yellowish-green, compact, patches, frequently on decaying wood. Stems 1–3 cm long, prostrate or procumbent, *branches numerous*, horizontal to patent; rhizoids scarce. Leaves imbricate, patent, *quadrate-ovate to oblong-ovate*, nearly symmetrical, the margins nearly equally curved, $\frac{1}{4}$ bilobed, the antical margin somewhat decurrent, the sinus lunate, *the lobes subulate and longly acuminate*, usually equal or nearly so, straight or somewhat connivent, less frequently slightly divergent; cells 33–42 μ, hexagonal, walls thin, trigones minute; cuticle smooth. Underleaves patent, divided to below the middle into two long, subulate, acuminate lobes, with a subulate tooth on one or both sides. Involucral bracts much larger than the leaves, broadly *ovate* to ovate-oval, $\frac{1}{3}$ bilobed, the sinus narrow, acute, the lobes subulate and *longly acuminate;* bracteole oval, $\frac{1}{2}$ or deeper bilobed, with generally a cilium or tooth on each side, the sinus narrow but rounded at base and reflexed, lobes longly acuminate, reflexed. Perianth *usually present*, oblong, triquetrous, the angles acute and occasionally winged, the mouth

deeply 3-lobed, the lobes *spinous-dentate and spinous-ciliate*. Capsule oblong-oval, dark brown. Spores 16–17 μ, reddish-brown, almost smooth. Elaters 9–10 μ, thick, bispiral. Androecia terminal on the branches, spicate, bracts in several pairs, closely imbricate, smaller than the leaves, unequally and acutely bilobed, the lobes acute, the antical lobe the smaller, saccate, the antical margin with an incurved lobe at the base. Antheridia single, nearly globose.

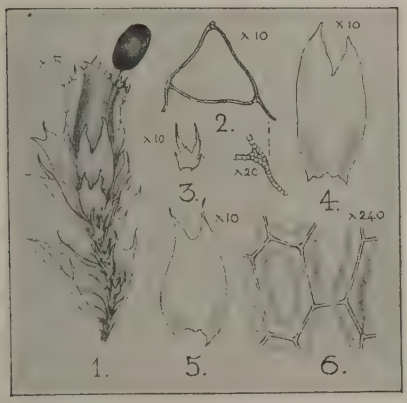
HAB. Decaying logs and stumps, and on banks and walls.

DISTRIB. N. to Shetland, common; Ireland. Fr. Mar.–July.

The monoicous inflorescence is the most important character to distinguish this species from *L. bidentata*, and as inflorescence is generally present in *L. cuspidata*, there is usually little difficulty in recognising the plant. Sterile plants of the two species can also be known, when typical, by the more asymmetrical, differently shaped leaves with shorter points and smaller cells of *L. bidentata*, but some forms occur which cannot be distinguished with certainty when without inflorescence. The mouth of the perianth is an important character in separating them. The involucral bracts and bracteole vary considerably in both plants, the margins being entire or with a tooth on one or both sides, rarely are they 3-lobed.

142. Lophocolea alata Mitt. ex Larter

Lophocolea alata Mitten ex Larter, Trans. Devon. Ass. Sc. Litt. Art p. 285 (1906); Macv., Journ. Bot. p. 260 (1907).
Lophocolea cuspidata var. *alata* K. Müll., Krypt. Fl. I p. 803 (1911).



1. Fertile stem. 2. Section of perianth. 3. Underleaf. 4. Bracteole. 5. Leaf. 6. Cells.

Monoicous. In *dark green* to dark yellowish-green patches, frequently among mosses. Stems 1–3 cm long, prostrate or procumbent, with numerous branches, *in habit resembling L. cuspidata*, but with leaves on the main stem rather broader and with *shorter and more unequal lobes*, the sinus lunate or obtuse, cells *larger*, 40-50 μ, generally more opaque and the trigones very minute. Underleaves commonly with a long, widely spreading, subulate tooth on both sides. Involucral bracts oblong-ovate, $\frac{1}{6}$–$\frac{1}{4}$ bilobed,

the sinus lunate, the lobes triangular-acuminate, margins usually entire; bracteole narrowly oblong to oval, $\frac{1}{5}$–$\frac{1}{4}$ bilobed, the sinus lunate, the lobes subulate, reflexed, usually entire. Perianth large and longly exserted, oblong, triquetrous, one or more of *the angles winged and more or less spinous-dentate*, seldom all entire, the wings with 3–9 single cells, the mouth deeply 3-lobed, the lobes acute to acuminate, the margins spinous-dentate to spinous-ciliate. Capsule oblong-oval, dark brown. Spores 15–18 μ, pale reddish-brown, nearly smooth. Elaters 9–10 μ, thick, reddish-brown, bispiral. Androecia as in *L. cuspidata*.

HAB. Moist banks and walls.

DISTRIB. N. to Berwick, frequent in the south, rarer northwards. Fr. Mar.–June.

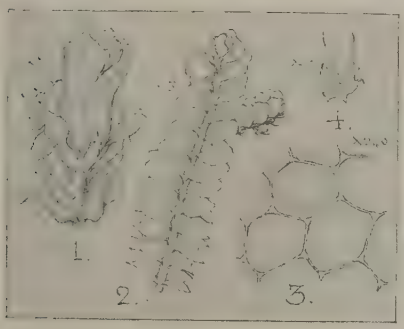
Closely allied to *L. cuspidata* and perhaps not always distinct from it, but it is seldom that any difficulty is found in recognising the plant, and it may be considered as a "small species." It is generally dark green, with the leaves rather broader and more asymmetrical than in *L. cuspidata*, and with considerably larger cells. The size of the cells varies in both plants, and Schiffner has a var. *grandiretis* in his *Krit. Bemerk.* in *Lotos*, p. 18, 1910, with cells larger than in typical *L. cuspidata*, but not so large as in *L. alata*. The perianth and involucral bracts of *L. alata* form fairly distinct characters. In *L. cuspidata* one or more angles of the perianth are occasionally winged and dentate, but probably never to such an extent as is seen in well-marked specimens of *L. alata*, though the size of the wings varies considerably in the latter. In the former one frequently sees only two of the angles with more than one row of cells, and all the angles are usually only obtusely keeled, while in the latter the three angles appear to have always more than one row of cells, and one or more always winged and frequently dentate. The wing varies in size, but is often composed of a single series of 6–9 cells superimposed on an angle thickened to the extent of several layers of cells. The mature bracts and bracteole are nearly always less deeply divided, and with the cuspidate points shorter than in *L. cuspidata*. The bracteole is by no means always oval as in Mitten's figure. It varies considerably in shape, and not rarely has a tooth on one or both sides, but it is nearly always less deeply lobed than in *L. cuspidata*. The plant has some resemblance to *L. bidentata* in the leaf, and in the mouth of the perianth being frequently not spinous-ciliate.

143. Lophocolea heterophylla (Schrad.) Dum.

Jungermannia heterophylla Schrad., Journ. für d. Bot. 5 p. 66 (1801).
Lophocolea heterophylla Dum., Rec. d'obs. p. 17 (1835); Nees, Eur. Leb. II p. 338 (1836).

Paroicous, rarely heteroicous. In flat pale *yellow*-green patches. Stems to 2 cm long, closely creeping, irregularly branched, the branches sometimes with small deeply and acutely bilobed leaves; rhizoids numerous, fasciculate. Leaves nearly horizontal, *oblong-quadrate*, *variously lobed*, the *lower* being smaller, distant or approximate,

bilobed with the sinus obtuse and lobes obtuse or acute, the *upper* larger, imbricate with the antical margin shortly decurrent, the apex slightly narrowed and either *rounded, truncate, retuse or broadly emarginate*; rarely all the leaves bilobed; cells 25–30 μ, polygonal, the walls thin, trigones generally present, small; cuticle smooth. Underleaves rather large, incurved but nearly appressed to the stem, bifid to below the middle into two subulate acuminate lobes, each generally with a tooth or cilium near the base. Involucral bracts erect, slightly larger than the leaves, oblong-cuneate to oblong-quadrate, retuse or shortly and irregularly 2–4-lobed; bracteole deeply bifid, the segments lanceolate with 1–3 cilia or teeth on the margin. Perianth terminal on rather short branches, longly exserted, cylindrical-beaker shaped, sharply 3-angled above, the mouth *shortly* trilobate, *lobes broadly lobulate or coarsely dentate*. Capsule oval. Spores 11–13 μ, yellow-brown, nearly smooth. Elaters reddish-brown. ♂ bracts in 3–5 pairs, suberect, nearly transversely inserted, immediately below the perianth, but occasionally at some distance below or on a special branch, of almost similar shape to the upper leaves but with an inflated lobule at the antical base. Antheridia single, globose.



1. Fertile stem. 2. Sterile stem with leaves. 3. Cells. 4. Underleaf.

HAB. Decaying logs and stumps and on sand rocks.

DISTRIB. N. to Kincardine, common except in Scotland; Ireland. Fr. Feb.–June.

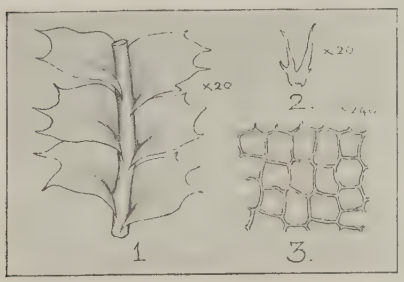
The inflorescence, which is nearly always paroicous, is usually present and at once distinguishes this species. In sterile plants the dimorphous leaves are generally a sufficient characteristic. The upper leaves are frequently antically secund. The stems are more closely attached to the substratum than is usual in the others, and the leaves are typically of a thicker texture; the chlorophyll granules fill the cells except in the centre, causing them to look opaque. The mouth of the perianth is quite different from that of *L. cuspidata* and its allies.

The *f. laxior* Nees has the leaves of the sterile stems more frequently emarginate or even bilobed. It is a less compact state of the plant. The *f. multiformis* Nees has many small sterile branches with leaves deeply and acutely bilobed. Both these forms may be seen growing with the typical plant into which they pass with all stages of intermediate forms.

L. minor, a calcicolous species, which should be looked for in Britain, is a smaller plant, with distant leaves which are usually erose through gemmae.

144. Lophocolea fragrans Moris et De Not.

Jungermannia fragrans Moris et De Not., Fl. Caprar. p. 119 (1839).
Lophocolea fragrans Moris et De Not. in G. L. N. Syn. Hep. p. 166 (1844).
Lophocolea spicata Tayl. in G. L. N. Syn. Hep. p. 167 (1844).



1. Stem with leaves. 2. Underleaf. 3. Cells.

Monoicous. Small and tender. In thin pale green patches on rocks or among mosses. Stems 9–14 mm long, prostrate, irregularly branched; rhizoids long, rather scarce. Leaves slightly imbricate, horizontal to ascending, oblong-*ovate* to quadrate-ovate, asymmetrical, the postical margin more curved, the antical margin shortly decurrent, *apex emarginate-bidentate*, *frequently tridentate* with the middle tooth the largest, *or the upper part of the postical margin* and occasionally the antical margin *with a small tooth*, seldom with more except at apex of stem, the teeth narrowly triangular and acute; cells *small*, *16–21* μ, *quadrate*-hexagonal, the walls thin, trigones absent or nearly so; cuticle smooth. Underleaves rather large but variable in size, patent, $\frac{1}{2}$–$\frac{2}{3}$ bifid, segments lanceolate, usually with a tooth or cilium near the base. Involucral bracts suberect; nearly similar to the leaves but slightly larger, broadly quadrate-ovate, bidentate and *irregularly dentate and denticulate in the upper part*; bracteole oblong, $\frac{1}{3}$–$\frac{1}{2}$ bifid, segments acuminate, usually with one or more teeth at the sides. Perianth oblong, triquetrous, the mouth wide and shortly trilobate, the lobes irregularly dentate and denticulate. ♂ bracts in 5–10 pairs, *narrowly* spicate at the apex of the branches, closely imbricate with the apices recurved, broadly ovate, complicate, the antical margin with a *large* inflated and slightly denticulate lobule. Antheridia single, large, oval-globose, shortly pedicellate.

Hab. On wet rocks, usually near the west coast, very rare.

Distrib. Cornwall to West Inverness; Ireland.

The small size of the leaf-cells is a good character to distinguish this from small forms of *L. bidentata* or *L. cuspidata*; also the leaf-lobes do not run into long cuspidate points as in the other two species, one or other of which is not

uncommonly found in mixture with it. The small size and irregular teeth of at least some of the leaves will nearly always distinguish it, and the monoicous inflorescence will also separate it from *L. bidentata*. The male spikes are very narrow and are conspicious at the end of the branches.

Schiffner states in his *Krit. Bemerk.* p. 21, 1910, that there is scarcely any doubt that the Italian *L. fragrans* and the western European *L. spicata* are not specifically different; also Müller in his *Krypt. Fl.* makes the latter a synonym of the former, after examination of an original specimen of *L. fragrans*. I have not had the opportunity of examining an authentic specimen of the latter.

XXXVI. CHILOSCYPHUS Corda

Cheiloscyphos Corda in Opiz, Beitr. 1 p. 651 (1829) (nom. corr. Dum., 1831); emend. Schiffn., Oest. bot. Zeit. no. 5 (1910).

Plants pale green to dark green. Stems irregularly branched, the branches lateral; rhizoids colourless, proceeding from the base of the underleaves. Leaves succubous, alternate, nearly longitudinally inserted, decurrent antically, generally undivided and with entire margins. Underleaves *everywhere present*, usually *bifid and with a tooth on one or both sides.* ♀ *inflorescence on very short lateral branches.* Bracts in few pairs, *much smaller than the leaves*, 2–3-lobed. Perianth campanulate with a wide 3-lobed mouth, the lobes entire or dentate. Calyptra *large*, usually extending beyond the perianth. Capsule on a long pedicel, ovate, the wall pluristratose. *Androecia intercalary on the stem or long branches, bracts resembling the leaves*, but saccate with a small, incurved lobule at the base of the antical margin.

Schiffner in *Oest. Bot. Zeit.* No. 5, p. 910, has limited this genus to species having intercalary androecia, with the bracts resembling the leaves. He has made into a separate genus, with the name *Heteroscyphus*, the species which have small, spicate androecia and with the bracts not at all resembling the leaves.

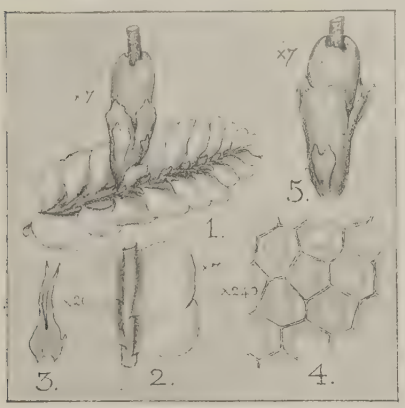
1 Leaf-cells 21–28 μ; plant blackish-green to dark green: usually in running water ..... *145. polyanthus* v. *rivularis*
1 Cells larger; plant paler green; not in running water 2

2 Cells 28–33 μ; plant usually brownish-green; mouth of perianth with entire lobes ..... *145. polyanthus*
2 Cells 35–50 μ; plant not brownish-green; mouth of perianth with spinous-dentate lobes 3

3 Pale green, leaves frequently emarginate and sometimes bilobed, cells usually 35–45 μ, transparent ..... *146. pallescens*
3 Dull green, leaves roundish-quadrate, seldom emarginate, cells usually 30–40 μ, not or slightly transparent ..... *145. polyanthus* v. *fragilis*

145. Chiloscyphus polyanthus (L.) Corda

Jungermannia polyanthos L., Sp. Plant. ed. 2 p. 1597 (1762).
Cheiloscyphos polyanthos Corda in Opiz, Beitr. 1 p. 651 (1829).



1. Fertile stem. 2. Leaves. 3. Underleaf. 4. Cells. 5. Perianth, etc., of var. *fragilis*.

Monoicous. In thin, flat, and generally loose, green to *brownish-green* patches in wet ground. Stems 2–5 cm long, prostrate or ascending, with several irregular branches; rhizoids fasciculate, proceeding from the base of the underleaves. Leaves imbricate, *almost longitudinally inserted*, slightly convex, ascending, *roundish-quadrate*, rounded at the apex or occasionally truncate or slightly emarginate, the antical margin decurrent; cells *28–33* μ, 5–7-angled, the walls thin, trigones minute; cuticle smooth. Underleaves small, oblong-ovate, more or less *deeply lobed*, the segments *subulate*, the margins with a tooth on one or both sides, or entire. ♀ inflorescence on very short lateral branches. Involucral bracts much smaller than the leaves, shortly bilobed, the lobes obtuse or acute, bracteole small, bilobed. Perianth goblet-shaped, deeply 3-lobed, the lobes obtuse, *entire*; calyptra clavate, exserted beyond the perianth. Capsule on a long pedicel, oval, the wall of 4–5 layers of cells. Spores 13–17 μ, yellowish-brown, finely granulate. Elaters 8–10 μ broad, reddish-brown, loosely bispiral. Androecia at the middle of the stem or long branches; bracts in several pairs, resembling the leaves but *with a small, saccate, inflexed lobe at the antical base*, containing usually a single subglobose antheridium.

var. rivularis (Schrad.) Nees, Eur. Leb. II p. 374 (1836).

Jungermannia pallescens β *rivularis* Schrad., Syst. Samml. Crypt. Gew. II p. 7 (1797).
Chiloscyphus rivularis Loeske, Abh. Bot. Ver. Prob. Brand. pp. 172–174 (1904).

In *blackish-green* to dark green tufts on stones *in running water*, or submerged in lakes. Stems rigid, decumbent, *much branched*, the

branches spreading, *equally leaved*; rhizoids scarce, short. Leaves *approximate to subdistant*, or slightly imbricate, nearly flat and horizontal, *oblong-rectangular* of *nearly equal width throughout*, rounded at the apex, seldom slightly emarginate; cells *small, 21–28 μ, opaque*, the walls thin, trigones absent. Underleaves most commonly small and tender, usually shortly bilobed, the segments subulate to filiform, the margins generally entire.

var. **fragilis** (Roth) K. Müll., Krypt. Fl. I p. 823 (1911).

Jungermannia fragilis Roth, Fl. Germ. 3 p. 370 (1803).
Chiloscyphus polyanthus var. *erectus* Schiffn., Lotos no. 7 p. 333 (1900).
Chiloscyphus fragilis Schiffn., Krit. Bemerk. in Lotos p. 27 (1910).

In large *erect* or decumbent, *dull green* or less frequently yellowish-green *tufts in springs and wet grassy ground*. Stems rather flaccid, elongated, slightly branched, the few branches ascending; rhizoids scarce. Leaves *very large and flaccid*, seldom small, imbricate, ascending, distinctly convex, *broadly oblong-quadrate to roundish-quadrate*, the apex rounded, rarely slightly emarginate; leaves on the branches distant and longly decurrent; cells *large*, 30–40 μ, sometimes larger, slightly transparent, the walls thin, trigones absent or minute. Underleaves small, bifid, frequently destroyed. Lobes of the mouth of perianth *with spinous-ciliate teeth*. Calyptra longly exserted. Spores 18 μ, yellowish-brown. Elaters 9 μ broad, bispiral.

DISTRIB. N. to Shetland, rather common; Ireland. Var. *rivularis*, N. to Inverness, rather rare; Ireland. Var. *fragilis*, N. to Perthshire. Fr. April to June.

None of our plants of this genus should be confused with any species of other genera. The bifid underleaves, together with the leaf-cells with very thin walls and trigones absent or very minute, should be sufficient to distinguish them. The characteristic male inflorescence is also very frequently present.

The typical plant most commonly occurs in brownish-green patches on rocks at the side of streams, or on wet soil. The cells are larger than in var. *rivularis*, but smaller than in the var. *fragilis*, or in *C. pallescens*. The lobes of the mouth of the perianth are entire.

The exsertion of the calyptra beyond the perianth is most noticeable after the extrusion of the capsule.

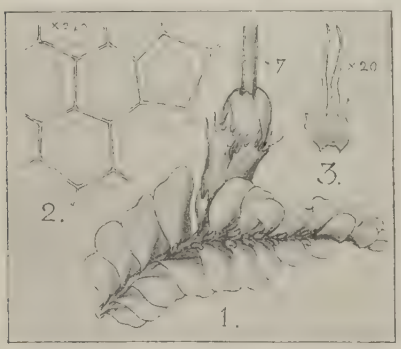
I have given var. *rivularis* only varietal rank with considerable doubt. It has apparently a form-circle of its own, as Schiffner states, and it might be regarded, as he considers, as a "small species." The cell-structure, rich branching and dark colour of the plant are fairly constant. Müller states that the small cells are owing to the plant growing in running water. I do not find that this is necessarily the case, as I have seen plants submerged in lakes from widely separated districts, in which the cells were quite as small as in the plant of running water. These submerged forms have sometimes broader and rounder leaves than in the plant of running water. The form of the leaf varies a good

deal in this variety, being sometimes rotundate-quadrate or oval, and the size of cells also varies to some extent, but it is seldom that difficulty is found in distinguishing it. Occasionally the leaves are considerably imbricate, and the underleaves are sometimes large towards the apex of the stem.

The var. *fragilis* has frequently been mistaken in Britain for *C. pallescens*. They have considerable resemblance to each other and probably cannot always be separated, however distinct they are when typical. The variety is chiefly characterized by its dull green colour and smaller, less transparent cells, but the size of the cells varies greatly in both plants. In the very large leaves which are frequent in the submerged form of var. *fragilis*, the cells are sometimes 50 μ in diameter, while the cells in *C. pallescens* are frequently only 35 μ. Both plants may also be yellowish-green. However, they can generally be distinguished without much difficulty, as the cells of the variety are usually more like those of *C. polyanthus*, the leaves are seldom emarginate and are rarely lobed, the underleaves are smaller, the plant is flaccid and the colour is duller green. The erect or ascending form on wet grassy ground has smaller leaves and is less flaccid than the submerged form in springs. The latter is sometimes very characteristic in alpine and subalpine localities. The var. *fragilis* has also sometimes been mistaken for the var. *rivularis*, but the cells are distinctly larger than in the latter. The distribution of the varieties in Britain requires revision. The var. *rivularis* is uncommon, but the var. *fragilis* is evidently frequent and is probably more so than *C. pallescens*.

146. Chiloscyphus pallescens (Ehrh.) Dum.

Jungermannia viticulosa L. p.p., Sp. Plant. p. 1597 (1753).
Jungermannia pallescens Ehrh., Pl. Crypt. Exs. 502; Hoffm., Deutsch. Fl. 2 p. 87 (1795).
Jungermannia polyanthos β *pallescens* Lindenb., Nov. Act. Ac. Caes. Leop.-Carol. 14 Suppl. p. 30 (1829).
Chiloscyphus pallescens Dum., Syll. Jung. p. 67 (1831).
Cheiloscyphos polyanthos β *pallescens* Hartm., Fl. Scand. ed. 10 p. 145 (1871).
Cheiloscyphus viticulosus Lindb., Musc. Scand. p. 4 (1879).



1. Fertile stem. 2. Cells. 3. Underleaf.

Monoicous. In thin, flat, *pale green or pale yellowish-green* patches at the side of ditches, wet grassy ground and on decaying logs, usually in less wet ground than the preceding. Stems prostrate or ascending, and rather sparingly branched. Leaves ascending, distinctly convex, *oblong-quadrate* to roundish-quadrate, larger than in *C. polyanthus*, *the apex very frequently truncate*, near the base of stem and *on the branches often rectangular and bilobed with acute or obtuse lobes*;

cells very large, *35–45 μ*, frequently to 50 *μ*, *transparent*, the walls thin, trigones minute. Underleaves *large*, patent, deeply bilobed, the segments subulate, the margin with a long tooth on one or both sides. Lobes of the mouth of perianth *spinous-dentate*. Calyptra longly exserted. Spores 13–17 *μ*, yellowish-brown, finely granulate. Elaters 8–9 *μ* broad, reddish-brown, bispiral.

DISTRIB. N. to Shetland, frequent; Ireland. Fr. April–June.

The frequently bilobed branch-leaves, which are mostly rectangular and not at all roundish-quadrate, the clear and transparent large cells, the large underleaves and the pale colour of the plant, are the characters which will distinguish well-marked specimens, but none of these characters are constant; the pale colour and large cells having most value. The size of the cells varies in all the forms of this plant and of *C. polyanthus*; large leaves have usually large cells and small leaves have small cells. It is advisable to take nearly equally-sized leaves for comparison and even then the amount of variation is considerable.

The underleaves have very commonly a long, subulate tooth on both sides; the apices of the segments are not filiferous.

C. pallescens can only be considered as a "small species," and its relation to the var. *fragilis* of *C. polyanthus* is very close.

XXXVII. HARPANTHUS Nees

Harpanthus Nees, Eur. Leb. II p. 351 (1836).

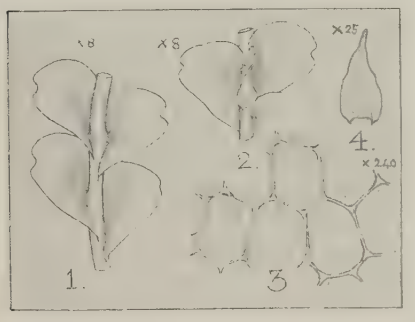
Stems slender, slightly branched, the branches nearly always postical. Leaves succubous, alternate, *emarginate or shortly bilobed. Underleaves large, triangular-lanceolate, usually entire* or with a tooth at the side, sometimes partly bifid, frequently connate at base on one side with the leaves. ♀ *inflorescence on very short postical branches*; bracts very small, 2–3-lobed, bracteole resembling the cauline underleaves. Perianth oblong, narrowed towards the mouth, *connate with the calyptra for two-thirds of its length and several layers thick at its lower part.* Calyptra free only near the apex. Capsule oval with a rather long pedicel, the wall of two layers of cells, the inner with semi-annular thickenings. *Androecia on short postical branches.*

The branches are nearly always postical in this genus and arise from the axil of the underleaves, but in *H. Flotowianus* the vegetative branches are occasionally lateral. The lower part of the perianth is fleshy, as the sporogonium becomes sunk in the apex of the branch, which becomes swollen and forms a cup; the calyptra also becomes adherent to the inner side of the perianth. The ♂ and ♀ branches are very short in the axils of the underleaves.

In wet alpine places ; stems 2–4 cm long ; leaves with a small round notch at the apex $\frac{1}{7}$–$\frac{1}{8}$ deep.....*147. Flotowianus*
On banks or on rotting wood on the low ground ; stems to 1·5 cm long ; leaves with a larger sinus $\frac{1}{5}$–$\frac{1}{4}$ deep .....*148. scutatus*

147. Harpanthus Flotowianus Nees

Jungermannia Flotowiana Nees in Diar. bot. Ratis. 2 p. 408 (1833).
Harpanthus Flotowianus Nees, Eur. Leb. II p. 353 (1836).



1. Stem and leaves, antical view. 2. Do. postical. 3. Cells. 4. Underleaf.

Dioicous. *In rather large erect, soft tufts* or among mosses, *yellowish-green to yellowish-brown* in colour. Stems 2–4 cm long, slender and rigid, *erect or ascending*, simple or sparingly branched, branches mostly postical ; rhizoids colourless, numerous and rather short. Leaves *flaccid*, approximate to imbricate, *very obliquely inserted*, the antical margin strongly decurrent, ascending and somewhat antically secund, roundish-ovate to triangular-ovate, the apex retuse or *shortly emarginate* with a *small lunate sinus* and short, unequal, *obtuse* lobes ; cells 28–36 μ, 5–6-angled, hyaline, the walls thin, *trigones small* ; cuticle smooth. *Underleaves large*, erecto-patent with the apex incurved, *ovate-lanceolate*, *usually entire*, occasionally with an obtuse tooth at side, sometimes bifid near base of stem. ♀ inflorescence bud-like on short postical branches. Involucral bracts small, very concave, 2–3-lobed, lobes acute or with an incurved lacinia, or obtuse ; bracteole ovate-lanceolate. Perianth cylindrical-subclavate, curved, triplicate at the apex, the mouth crenulate. Capsule oval, brown. Spores 9–12 μ, brown. ♂ branches geminate, short, postical, bracts in 2–5 pairs, small, complicate-concave with an antical tooth at base, shortly bilobed, lobes with an acute, incurved point ; antheridia 1–2, broadly oval.

Hab. Side of streamlets, wet banks and moist places, alpine, ascending to 3200 ft. alt., rarely subalpine.

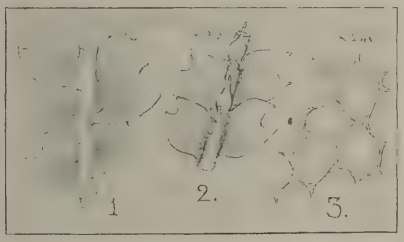
Distrib. Kirkcudbright to Shetland, rare.

Forms large flaccid tufts in wet ground in alpine places; it does not bear any resemblance to the small, green, decumbent, low ground *H. scutatus*. It is sometimes confused with *Lophozia bantriensis*, which is in fact the only plant at all like it. The very different position of the inflorescence, which is common in both, will at once distinguish them. The *Harpanthus* has also larger and much broader underleaves, which are usually entire, at least in the upper part of the stem, while in the other they are more or less laciniate. The small lunate sinus and small lobes can always be found on some of the leaves and will distinguish the species in the field from the *Lophozia* with its broad sinus and broad lobes.

It can easily be overlooked in the field for suberect forms of *Chiloscyphus*, which occasionally grows in similar habitats on the hills, as in marshy ground at the side of rills.

148. Harpanthus scutatus (Web. et Mohr) Spruce

Jungermannia scutata Web. et Mohr, Bot. Taschenbuch p. 408 (1807).
Jungermannia stipulacea Hook., Brit. Jung. *pl.* 41 (1813).
Lophozia scutata Dum., Rec. d'obs. p. 17 (1835).
Harpanthus scutatus Spruce, Trans. Bot. Soc. Ed. 3 p. 209 (1845).



1. Stem and leaves, antical view. 2. Do., postical. 3. Cells.

Dioicous. *In small patches* or among mosses, *pale green*, becoming reddish or yellowish-brown when dry. Stems to 15 mm long, *slender*, pale green, *prostrate with ascending apex*, sparingly branched, the branches postical; rhizoids long and colourless, rather numerous to near apex of stem. Leaves approximate to imbricate, ascending to suberect, *broadly oval* to oval-oblong, the antical margin decurrent, $\frac{1}{5}$–$\frac{1}{4}$ bilobed, sinus variable but *most commonly lunate*, lobes somewhat unequal, *acute*, *frequently connivent;* cells 24–30 μ, *rounded*-polygonal, the marginal row subquadrate, walls thin, *trigones rather large*, *distinct;* cuticle nearly smooth. *Underleaves large*, erecto-patent with the apex usually incurved, *the base connate on one side* with the adjoining leaf, *oblong-ovate*, acute or obtuse, entire or with a tooth on one or both sides. ♀ inflorescence bud-like on very short postical branches. Involucral bracts small, appressed, oblong-oval, 2–3-lobed, the lobes acute; bracteole oblong-ovate acute. Perianth oblong-oval, narrowed above, the mouth denticulate. Capsule oval, reddish-brown. Spores 8–10 μ, pale reddish-brown, granulate. Elaters reddish-brown, bispiral, hardly attenuate. ♂ bracts in 3–4 pairs, imbricate, on

short postical branches, *small*, complicate-concave, $\frac{1}{3}$ bilobed; antheridia 1–2, oval.

Hab. Moist peaty banks, sand rocks and decaying logs.

Distrib. N. to Ross, rare; Ireland. Fr. May–July.

This species forms small patches which are of a conspicuous pale green colour, frequently in company with *Scapania umbrosa*. It might be overlooked for *Lophozia porphyroleuca*, which is also often frequently pale green when in shade, but the latter is at once known by the absence of underleaves. It bears some resemblance to *Lophozia Muelleri*, but the *Harpanthus* has larger underleaves, broadly oval and attached to the base of the adjacent leaf, more connivent leaf-lobes and smaller trigones. The trigones are small and rather indistinct when the plant occurs in wetter ground than usual. The direction of the leaves on the stem is very variable; they are sometimes suberect and appearing as if nearly transverse on parts of the stem. In the lax forms the leaves are much decurrent. Galls, caused by the nematode worm *Telenchus Davainii*, are found in this species. They form small heads at the apex of the stem and branches.

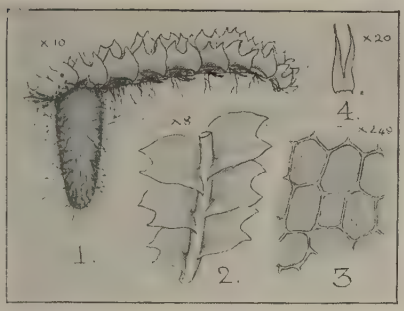
XXXVIII. GEOCALYX Nees

Geocalyx Nees, Eur. Leb. I p. 97 (1833).

Plants with the habit of *Lophocolea*. Stems simple or slightly branched, the branches postical. Leaves succubous, alternate, *bilobed*, the antical margin shortly decurrent. Underleaves rather large, *deeply bifid*, sometimes connate at the base on one side with the leaves. ♀ *inflorescence on a very short postical branch*, gemmiform, at length becoming *an oblong*, *fleshy*, *pendulous perigynium*, bearing near its mouth a few scale-like bracts. *Perianth absent*. Calyptra shorter than the perigynium and *connate with it for two-thirds of its length*, the sterile archegonia situated near the base of the free portion. Capsule cylindrical-oval, 4-valved to the base, the valves erect and straight, the wall of two layers of cells, the inner layer with semi-annular thickenings. *Androecia on short postical branches*, bracts 6–8 pairs, shortly bilobed, monandrous.

149. Geocalyx graveolens (Schrad.) Nees

Jungermannia graveolens Schrad., Syst. Samml. Krypt. Gew. 2 p. 6 (1797).
Geocalyx graveolens Nees, Eur. Leb. II p. 397 (1836).
Saccogyna graveolens Lindb., Hep. in Hib. lect. p. 509 (1875).



1. Fertile stem. 2. Sterile stem. 3. Cells. 4. Underleaf.

Monoicous. In thin flat, *yellowish-green* or green patches, or scattered over mosses. Stems to 2 cm long, simple or sparingly branched, *closely creeping*; rhizoids rather numerous, long and colourless. Leaves nearly flat, almost horizontal, frequently shortly decurved, slightly imbricate, ovate-quadrate, *very obliquely* inserted, the antical margin nearly straight and shortly decurrent, the postical margin more rounded, $\frac{1}{3}$ bilobed, *sinus very variable*, round, right-angled, or less frequently acute, lobes broadly triangular, usually acute and somewhat unequal; cells 25–30 μ, polygonal, walls thin, *trigones small*; cuticle finely punctate. Underleaves appressed, *oblong*, $\frac{3}{4}$ *bilobed*, sinus narrow, *lobes nearly parallel*, *entire*, lanceolate-acuminate. Perigynium cylindrical, sparingly radicellose, the mouth with 4–5 small scale-like bracts which become destroyed at the maturity of the capsule. Capsule almost cylindrical, brown, inner wall with numerous semi-annular thickenings. Spores 8–10 μ, yellowish-brown, almost smooth. Elaters bispiral. ♂ bracts shortly spicate, bracts in 6–8 pairs, imbricate, ventricose, shortly bilobed, lobes acute, incurved, the antical margin with an incurved tooth at base. Antheridia solitary, large, globose, shortly pedicellate.

Hab. Shady rocky banks.

Distrib. Kyle, West Ross, 1902 *(Macvicar)*.

The leaf-lobes usually end in a 1–3-celled point; some leaves are small with acute lobes and sinus. The perigynium in its early stage is nearly spherical; the ♂ branches are conspicuous under the microscope. Limpricht remarks that the fresh plant has a smell of turpentine.

This species more resembles, in the field, *Acrobolus Wilsonii* than any other, but it might also be overlooked for *Lophozia ventricosa*, *L. excisa* or *L. Muelleri*. Although it has the habit of a *Lophocolea*, it is without the long pointed lobes of *L. bidentata* or *L. cuspidata*, and it has not their transparent appearance of leaf. It is more like those forms of *L. heterophylla* which have all the leaves bilobed. The different position of the inflorescence will distinguish it from any *Lophocolea* or *Lophozia*; if this be not present, the bifid underleaves with their entire and nearly parallel segments will readily make it known.

It might be confused with the Continental *Lophocolea minor*, which may occur in Britain; but the latter is a smaller plant with some of its leaves nearly always erose through gemmae.

XXXIX. SACCOGYNA Dum.

Saccogyna Dum., Comm. Bot. p. 113 (1822).

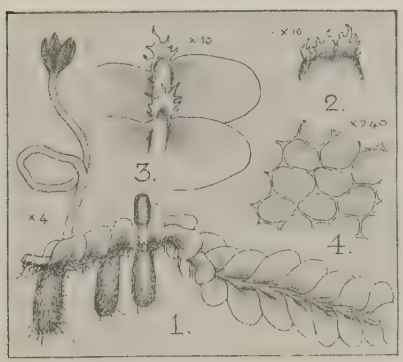
Plants with the habit of *Chiloscyphus*. Stems slightly and irregularly branched, the branches postical. Leaves succubous, *subopposite*, *entire*, shortly connate at the antical base or free, shortly decurrent. Underleaves large, deeply bifid or dentate, *frequently connate at the base with the leaves*. Inflorescence as in *Geocalyx*, but with a more distinct collar-like outgrowth upon the foot of the sporogonium.

150. Saccogyna viticulosa (Sm.) Dum.

Jungermannia terrestris, viticulis longis Mich., Nov. Pl. Gen. p. 8 *pl.* 5 f. 4 (1729).

Jungermannia viticulosa Sm., Eng. Bot. *pl.* 2513 (1813); Hook., Brit. Jung. *pl.* 60 (1813).

Saccogyna viticulosa Dum., Comm. Bot. p. 113 (1822).



1. Fertile stem. 2. Mouth of perigynium. 3. Stem, postical view. 4. Cells.

Dioicous, also monoicous? In *widely extended*, *flat*, *yellowish-green* to olive-brown patches on moist rocks, or creeping over mosses. Stems 2–5 cm long, pale green, somewhat rigid, sparingly branched; rhizoids scarce, colourless, almost confined to base of underleaves. Leaves *firm*, alternate to subopposite, regularly imbricate, *nearly horizontal* but slightly ascending, slightly convex, *oblong-ovate*, *entire*, the antical margin strongly decurrent, *the postical margins subopposite at base;* cells 23–28 μ, *rounded*-polygonal, *opaque*, with several large green chloroplasts, the walls thin, trigones small; cuticle *minutely and distinctly verruculose*. Underleaves as broad as, or broader than, the stem, connate at the base with one or both leaves, rotundate to *broadly triangular-ovate*, the apex generally acuminate, *the margins dentate and laciniate-ciliate*. Perigynium cylindrical, sparsely radicellose, the mouth with small irregularly dentate

bracts. Capsule longly pedicellate, nearly cylindrical, 4-valved to the base, inner wall with numerous semi-annular thickenings. Spores 10–14 μ, pale brown, granular-punctate. Elaters 6–8 μ broad, closely bispiral, reddish-brown. ♂ bracts on very short postical branches, bracts in 4–5 pairs, imbricate, spicate, ventricose, emarginate or shortly bilobed, lobes acute or acuminate, the antical margin with a tooth. Antheridia 1–2, large, broadly oval, shortly pedicellate.

HAB. Wet rocks and among mosses on moist rocky banks.

DISTRIB. N. to Shetland, frequent to common on the west coast, rare elsewhere; Ireland.

This Atlantic species is sometimes confused by beginners with *Chiloscyphus*, but it can be distinguished readily by the subopposite leaves, most marked from the postical side of the stem, with their bases generally attached on one side at least to the underleaf; the underleaf is of a different shape from that of *Chiloscyphus* and is not bifid at the apex; the plant is also not at all flaccid, and the cell-structure is different. Single stems are long, and trail over mosses on wet banks; the leaves are green in wet and shady places, but are reddish-brown in more exposed ground. Sterile ♀ plants are common, the ♂ is rarer and fruit very rare. The time of fruiting appears to extend over most of the year.

Some authors have recently described this species as monoicous. As far as I have observed, it appears to be dioicous.

Linnaeus is usually given as the author of the specific name, as his first reference, that to Micheli's figure, belongs to this species. His other reference however, to Dillenius' figure, belongs to *Chiloscyphus pallescens*. This in itself would not be sufficient to disallow Linnaeus as the authority for the name, but in *Spec. Plant.* he describes the underleaves as being subulate, though Smith mentions that this was erased in Linnaeus' own copy; yet a further blunder is made in *Syst. Nat.*, where he describes the leaves as being linear. This appears to me to show that it is quite uncertain what plant he intended by his *Jung. viticulosa*.

SUBFAMILY **Cephalozioideae**

Trigonantheae Spruce; *Trigonantheae* Schiffn.; *Cephaloziaceae* Cavers.

Leaves frequently incubous, more or less deeply divided at the usually broad truncate apex into 2–4, or rarely 6 teeth or lobes, seldom quite entire, the margin never recurved. Underleaves mostly present and small, rarely nearly as large as the leaves. ♀ *inflorescence cladogenous, on postical branches*, seldom on lateral, or acrogenous; *bracts usually tristichous*. Perianth generally long and

narrow, *trigonous with the third angle postical*, rarely 4–6-angled. One European genus (*Calypogeia*) marsupial. Capsule 4-valved with straight valves (in *Calypogeia* twisted). Elaters bispiral. Androecia very often on small postical branches; male bracts monandrous, very rarely diandrous.

XL. CEPHALOZIA Dum.

Jungermannia Sect. *Cephalozia* Dum., Syll. Jung. p. 60 (1831).
Cephalozia Dum., Rec. d'obs. p. 18 (1835).
Trigonanthus Spruce, Trans. Bot. Soc. Ed. 3 p. 207 (1849).
Cephalozia subgen. *Eucephalozia* Spruce, On Ceph. p. 30 (1882).

Plants usually small, greenish-white to brownish, simple or with few branches, *the branches postical*. Flagella frequently present. Leaves *obliquely inserted*, succubous, flat or somewhat channelled, 2-lobed, the margins entire; cells large, transparent, hexagonal. Underleaves absent on the stem or small, always present in the ♀ involucre. ♀ *inflorescence cladogenous*, *rarely acrogenous*; bracts larger than the leaves, *nearly always tristichous* (with the bracteole added), the bracteole being free or connate only at the base with the bracts. Perianth elongate, *trigonous with the third angle postical*, the mouth constricted, dentate or ciliate. Capsule longly exserted, the walls of two layers of cells, inner layer with semi-annular thickenings. Pedicel of capsule usually composed of eight outer cells and four smaller inner cells. Androecium spicate or amentiform, seldom hypogynous; bracts monandrous.

This genus is mostly composed of small tender species with the cortical cells of the stem pellucid. The branches are postical, the leaves oblique, more or less concave, seldom bilobed to below the middle and usually with acute and frequently connivent lobes, the cells are most frequently rather large and pellucid. The ♀ inflorescence is nearly always cladogenous and the perianth trigonous.

The genus is variously limited by authors, some including *Cephaloziella* as a subgenus, others including also *Prionolobus*, *Pleuroclada* and even *Hygrobiella*.

Considerable difficulty will be found in distinguishing some of the species of *Cephalozia* and most of those of *Cephaloziella*. The inflorescence must be determined in each case, and this is by no means always easy, the slender stems being very readily broken. In *Cephalozia* the presence or absence of flagella, decurrence of the leaf, depth of sinus and size of cells, and the involucral bracts are in general the most important characters to recognise.

1 { Stems with flagella 2
  Stems without flagella 7

2 { Lobes of leaf obtuse or obtusely pointed ; dioicous 3
  Lobes acute (cf. *ambigua*) ; monoicous 4

3 { Minute ; on banks ; leaves concave, $\frac{1}{6}$–$\frac{1}{5}$ bilobed, cells 17–23 μ *162. Francisci*
  Rather large ; aquatic ; leaves nearly flat, $\frac{1}{5}$–$\frac{1}{3}$ bilobed, cells 35–42 μ *163. fluitans*

4 { Minute ; stems 4–7 mm long ; leaves suberect to almost appressed, lobes frequently obtuse, cells 20–35 μ ..... *153. ambigua*
  Larger ; leaves patent to erecto-patent, cells 30–50 μ 5

5 { Leaves quadrate-oval, $\frac{1}{2}$ bilobed ; leaves on sterile stems frequently $\frac{2}{3}$ bilobed with subulate segments ; perianth of 1 layer of cells at the middle *151. bicuspidata*
  Leaves rotundate to rotund-oval, $\frac{1}{3}$–$\frac{1}{2}$ bilobed ; perianth of 2 layers of cells at the middle 6

6 { Leaves almost longitudinally inserted, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, cells 35–50 μ ; bracts bilobed to below the middle ..... *155. macrantha*
  Leaves obliquely inserted, $\frac{1}{3}$ bilobed, cells 30–45 μ ; bracts $\frac{1}{4}$–$\frac{1}{3}$ bilobed *154. pleniceps*

7 { Antical margin of leaf decurrent 8
  Antical margin not or hardly decurrent 12

8 { Monoicous ; bracts deeply divided into 3–5 lanceolate segments ; mouth of perianth longly ciliate ..... *156. connivens*
  Dioicous ; bracts 2-lobed with frequently a small third lobe at side 9

9 { Leaves greatly decurrent, lobes long and incurved, generally ending in three single cells ..... *157. hibernica*
  Leaves less decurrent, lobes ending in 1–2 single cells 10

10 { Lobes of bracts entire ..... *158. media*
  Lobes dentate 11

11 { On decaying wood, seldom on soil ; leaf-cells 16–21 μ ; ♂ bracts in few pairs *160. serriflora*
  Among Sphagnum ; leaf-cells 23–30 μ ; ♂ bracts in many pairs *159. macrostachya*

12 { Stems 1·5–3 cm long ; leaves obliquely inserted, cells 35–42 μ *152. Lammersiana*
  Stems to 1 cm long ; leaves small, nearly transversely inserted, cells 12–18 μ *161. leucantha*

Subgen. **Eucephalozia** Spruce

Eucephalozia Spruce, On Ceph. p. 30 (1882) emend. K. Müll., Rabh., Krypt. Fl. II p. 14 (1912).

Eucephalozia (gen.) subgen. *Pellucidae* Schiffn. in Engl. and Prantl 1. 3 p. 97 (1895).

Cortical layer of cells of stem more or less pellucid. Leaves $\frac{1}{3}$–$\frac{1}{2}$ bilobed or deeper, with generally acute lobes. Underleaves seldom present on the stem.

151. Cephalozia bicuspidata (L.) Dum.

Jungermannia bicuspidata L., Sp. Pl. p. 1132 (1753); Hook., Brit. Jung. *pl.* 11 excl. var. *β* (1812).
Cephalozia bicuspidata Dum., Rec. d'obs. p. 18 (1835).

1. Fertile plant. 2. Bracts. 3. Bracteole. 4. Leaves on stem. 5. Cells.

Monoicous. In *whitish-green* or dark green, occasionally rosy patches, or scattered among mosses. Stems ·5–2 cm long, pale green, prostrate or ascending, irregularly branched, with small-leaved *flagella*; rhizoids scattered, colourless. Lower leaves smaller and distant, upper leaves larger and subimbricate to imbricate, obliquely to nearly transversely inserted, *not decurrent*, patent to erecto-patent, concave, oval or quadrate-oval, ½ bilobed, sinus rounded or obtuse, *lobes lanceolate*, slightly unequal, straight or somewhat incurved; leaves on the branches frequently small, divergent, flat, and bifid to near the base into subulate segments; cells *large*, *35–42 μ*, pellucid, irregularly polygonal, walls *only slightly* but equally thickened; cuticle smooth. Underleaves absent. ♀ inflorescence on a *short*, rarely elongate, postical branch. Involucral bracts large, ½ bilobed, lobes lanceolate-acuminate, entire or with one or more teeth near the base; bracteole resembling the bracts. Perianth subfusiform, trigono-prismatic above, of one layer of cells except occasionally at the base, the mouth constricted, *denticulate or setulose*. Capsule oblong-oval, blackish-brown. Spores 12–16 *μ*, cinnamon-brown, thickly papillose; elaters reddish-brown. Androecium spicate at the middle or end of the branches, bracts ascending, nearly similar to the leaves, but more concave, frequently with an antical tooth at base. Antheridia globose. Gemmae rare, whitish-green, spherical, 1-celled, in clusters at the apex of the stem or branches.

var. **grandiflora** Spruce, On Ceph. p. 42 (1882).

Larger than the type, bracts remotely but coarsely laciniate-

dentate and dentate, frequently sinuate-lobate, sometimes recurved at the apex: perianth large, acro- and cladocarpous.

var. **setulosa** Spruce, On Ceph. p. 42 (1882).

Small, leaves small, lobes subapiculate; mouth of perianth truncate, setulose, the setae 2–3 cells long, laciniae of the bracts broadly subulate, acuminate with 1–2 spinous teeth on the margin. (Spruce *loc. cit.*)

var. **conferta** Hüben., Hep. Germ. p. 171 (1834).

In dense compact patches. Sterile stems suberect with imbricated leaves: leaves more transverse, concave, the apex of lobe frequently incurved; involucral bracts entire or nearly so; perianth rather short.

HAB. On moist soil in many situations from sea-level to 3800 ft. alt.

DISTRIB. N. to Shetland, very common except on chalk; Ireland. Fr. Feb.–June.

This common species is very variable in habit, colour and size: some forms have leaves with divaricate, or at least parallel lobes, others have them considerably connivent: sometimes the insertion of leaf is nearly transverse. In general, the very small forms of this species can be known at once under the microscope from other small species of this genus and of *Cephaloziella* by the large leaf-cells. The monoicous inflorescence can usually be found without difficulty, and the flagella are frequently plentiful except in plants of wet ground. Underleaves are occasionally to be seen on the ♂ spike. Gemmae are rare in this species; the clusters are composed of partly branched chains of gemmae.

The var. *grandiflora* is monoicous and flagelliferous. A specimen which I received from Mr. Slater with the label "var. *macrathelia* Spruce, Stocton Forest, Aug. 1842, leg. R. Spruce" is, as Mr. Slater remarked, the same form. The var. *setulosa* is a common small form and does not appear to be very distinct, judging from a small piece of the original specimen. The var. *conferta* usually occurs in sandy ground and is probably widely distributed in Britain: the compact patches with the suberect sterile stems and imbricated leaves are noticeable.

Alpine forms have most commonly concave leaves with connivent lobes and the perianth may be thickened to slightly above the base, but such forms can be distinguished from *C. pleniceps* by the leaves of some of the branches showing the characteristic form of the species, being longer than broad and with long acuminate segments; the perianth is also not two cells thick as high as the middle.

A rare Continental species, *C. lacinulata* Jack, somewhat resembles very small forms of this species, but is dioicous, and has the mouth of the perianth with longly acuminate laciniae. It is found on decaying wood.

152. Cephalozia Lammersiana (Hüb.) Spruce

Jungermannia Lammersiana Hüben., Hep. Germ. p. 165 (1834).
Jungermannia bicuspidata γ uliginosa Nees, Eur. Leb. II p. 253 (1836).
Cephalozia Lammersiana Spruce, On Ceph. p. 43 (1882).
Cephalozia bicuspidata var. *Lammersiana* Breidl., Mitt. Nat. Ver. Steierm. p. 329 (1893).

1. Fertile plant. 2. Bracts. 3. Bracteole. 4. Leaves and underleaves on stem. 5. Leaf. 6. Cells.

Monoicous and pseudo-dioicous. In *rather compact* and somewhat intricate tufts, green to pale brown, sometimes tinged with reddish-brown. Stems 1·5–3 cm long, pale green, ascending, sparingly branched, *flagella absent or rare*; rhizoids scattered, colourless. Leaves *rather distant*, seldom approximate, obliquely inserted, not decurrent, patent to erecto-patent, *distinctly concave*, oblong-oval to oval-rotundate, ½ to *nearly* ⅔ *bilobed*, sinus obtuse or rounded, the lobes triangular-lanceolate, *unequal*, acuminate, usually *incurved and somewhat connivent*; cells 35–42 μ, pellucid, irregularly polygonal, the walls slightly and equally thickened; cuticle smooth. Underleaves present on the ♂ stems, subulate, otherwise absent. ♀ inflorescence on *elongate, rarely short postical branches*. Involucral bracts elongate, narrowly oblong, the margins *entire* or sinuate, frequently with a tooth on one side, divided *to below the middle* into two lanceolate-subulate, acuminate, entire lobes; bracteole oblong-ovate, the margin generally with a broad tooth on one side, bilobed to below the middle. Perianth subfusiform, trigono-prismatic above, of one layer of cells except at the base, the mouth contracted, denticulate or setulose. Capsule oblong, reddish-brown. Spores 12–15 μ, cinnamon-brown, thickly papillose; elaters 9–12 μ, reddish-brown, hardly attenuate. Androecium spicate on a long or short branch, bracts in 6–8 pairs, imbricate, concave, rarely resembling the leaves.

var. **serratiflora** Schiffn., Lotos No. 7 p. 337 (1900).

C. Lammersiana var. *grandifolia* Spruce MS. ?

Involucral bracts sharply dentate.

HAB. In wet ground as at the side of ditches and streamlets, marshes, bogs and wet peat-mosses, rarely ascending above 2000 ft. alt.

DISTRIB. N. to Shetland, uncommon; Ireland. Fr. May–June.

This may be considered a "small species" which is probably not always separable from *C. bicuspidata*. It is larger than that species, the leaves generally more concave, lobes more unequal, perianths on elongate leafy branches, seldom on a short one, bracts more elongate, more deeply lobed, the lobes longer and nearly always entire, underleaves distinct on the ♂ stems.

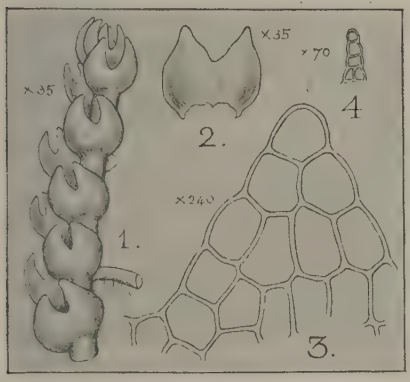
Spruce's var. *grandifolia*, which may be the same as Schiffner's plant which I have not seen, is a stout plant with large leaves and with the involucral bracts and bracteole sharply dentate and shortly laciniate. The ♀ inflorescence is at the end of long branches and the other characters are those of *C. Lammersiana*. In is an analagous form to the var. *grandiflora* of *C. bicuspidata*; the two plants are sometimes confused in herbaria.

153. Cephalozia ambigua Massal.

Cephalozia bicuspidata var. *atra* Arnell, Lebermoosstud. Nörd. Norv. p. 10, 1892 (fide K. Müller).

Cephalozia bicuspidata var. *artica* Bryhn and Kaal., Report Sec. Norv. Arct. Exped. "Fram" Bryophyta p. 44, 1906 (fide K. Müller).

Cephalozia ambigua Massal., Spec. Ital. gen. Ceph. in Malpighia 21 p. 22 (1907); K. Müll., Rabh. Krypt. Fl. II p. 26 (1912).



1. Part of stem with leaves. 2. Leaf. 3. Cells. 4. Underleaf.

Monoicous. Minute. In compact, dark yellowish-brown to blackish-brown patches. Stems 4–7 mm long, ascending, irregularly and considerably branched, denudate at base, *with several flagella*; rhizoids short, rather numerous. Leaves mostly imbricate, nearly transversely inserted, not decurrent, *suberect to almost appressed to the stem, strongly concave*, broadly ovate to *quadrate-ovate*, $\frac{1}{3}$ to almost $\frac{1}{2}$ bilobed, the sinus rounded-obtuse, lobes triangular-ovate, acute or obtuse, *usually incurved*; cells *small, 22–30 μ, but frequently to 35 μ*, the walls *distinctly* and equally thickened Underleaves absent, or sometimes

a few, minute and subulate, near the apex of the stems. ♀ inflorescence on short postical branches. Involucral bracts twice as large as the leaves, $\frac{1}{3}$ bilobed, the lobes subobtuse or acute, entire; bracteole slightly narrower than the bracts, $\frac{1}{3}$ bilobed, connate at the base with the bracts. Perianth deeply trigono-prismatic, the mouth crenulate. Androecium at the end or middle of the branches, bracts similar to the leaves.

HAB. On bare, moist soil about the summit of the higher mountains.

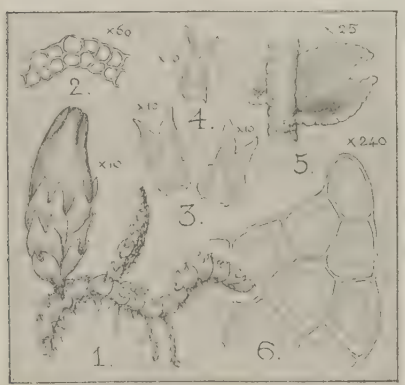
DISTRIB. Glas Meol, Perthshire, 1904 *(P. Ewing)*. Ben Lawers *(W. E. Nicholson)*.

C. ambigua is a derivative of *C. bicuspidata*, but can be readily distinguished by its small size, strongly concave and frequently almost appressed leaves and especially by its much smaller cells. Alpine forms of *C. bicuspidata* have large cells as in the plant of the low ground, and the lobes are more acute than is usual in the present plant.

This alpine-arctic species has only been recently noted in Britain. It will probably be found near the summits of several of our higher hills.

154. Cephalozia pleniceps (Aust.) Lindb.

Jungermannia pleniceps Aust. in Proc. Acad. Nat. Sc. Phil. p. 222 (1869).
Cephalozia crassiflora Spruce, On Ceph. p. 40 (1882).
Cephalozia pleniceps Lindb., Meddel. Soc. F. Fl. Fenn. 9 p. 158 (1883); Howe, Mem. Torr. Bot. Club 7 p. 125 *pl.* 104 (1899).



1. Fertile plant. 2. Part of section of perianth. 3. Bracts. 4. Bracteole. 5. Leaf. 6. Cells.

Monoicous. In small, usually dense, pale green patches. Stems 6–15 mm long, flattened dorsally, sparingly branched, and *with flagella;* rhizoids long and colourless. Leaves *thick*, subimbricate, concave, obliquely inserted, somewhat antically secund, the antical *margin hardly or very shortly decurrent*, obliquely ovate-*rotund*, about $\frac{1}{3}$ bilobed, sinus lunate or only obtuse, *lobes ovate-triangular, acute to subobtuse, generally more or less connivent and incurved;* cells 30–45 μ, quadrate-hexagonal,

pellucid, walls very slightly and equally thickened; cuticle smooth. Underleaves absent. ♀ inflorescence on a very short postical branch. Involucral bracts *narrowly oblong*, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, the margin entire or with an obtuse tooth on one or both sides, or occasionally shortly 3–4-lobed, the sinus narrow, segments lanceolate, *subobtuse*, entire; bracteole resembling the bracts but narrower. Perianth *cylindrical below*, trigonous above, *of 2–3 layers of cells from the base to above the middle*, the mouth contracted, crenulate-dentate. Capsule cylindrical-oval, chestnut-brown. Spores 12–14 μ, reddish-brown, densely papillose; elaters bispiral, pale reddish-brown. Androecium spicate, median or terminal, bracts resembling the leaves but with an inflexed tooth at the antical base. Antheridia oval-globose, shortly pedicellate.

HAB. On moist rock ledges and banks, alpine, descending to 1800 ft. alt. in Perthshire.

DISTRIB. Perth to Sutherland, rare. Fr. June–July.

Distinguished from some alpine forms of *C. bicuspidata*, with which it might be confused, by the general thick appearance of the plant, leaves more oblique and rounder in shape, being only about as long as broad, sinus shallower, lobes broader, and never lanceolate and more connivent, lobes of bracts more obtuse, and the perianth composed of about three layers of cells at the base and two layers to the middle or beyond. The two species frequently grow in mixture. The present plant has more resemblance to *C. media*, but this in not an alpine plant with us, and it has the leaves distinctly and usually considerably channelled, is without flagella, and is dioicous, besides other differences.

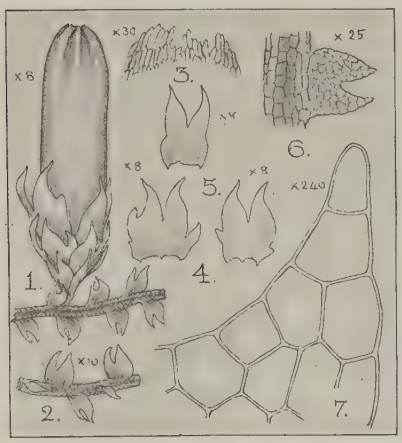
The involucral bracts are frequently, perhaps generally, composed of two layers of cells at the base.

155. Cephalozia macrantha Kaal. et Nichols.

Cephalozia macrantha Kaal. et Nicholson, Journ. Bot. p. 105 *pl.* 512 (1911).
Cephalozia pleniceps var. *macrantha* K. Müll., Rabh. Krypt. Fl. II p. 31 (1912).

Monoicous; also pseudo-diocious. In thin, pale or dull green patches among Sphagnum. Stems 10–15 mm long, prostrate or ascending, frequently with several branches, the branches denudate at base, *flagella present*, short, the whole plant closely creeping, with numerous long, colourless rhizoids. Leaves *distant*, slightly concave to flat, obliquely to almost longitudinally inserted, somewhat antically secund, the antical margin shortly decurrent, rotundate to rotund-quadrate, $\frac{1}{3}$–$\frac{1}{2}$ *bilobed*, the sinus obtuse to lunate, or *sometimes narrow and acute*, lobes usually unequal, acute or subacute,

ending in 1–2 cells, *slightly incurved* and sometimes connivent; cells large, *35–50* μ, quadrate-hexagonal, pellucid, the walls thin, trigones absent; cuticle smooth. Underleaves rather scarce, but here and there present and lanceolate-subulate. ♀ inflorescence on an *elongated* or sometimes short branch. Involucral bracts *oblong-ovate, bilobed to below the middle*, the margins with a large tooth on one or both sides, the sinus acute or obtuse, the lobes lanceolate, acute or subacuminate, entire; bracteole resembling the bracts but narrower and with the margins generally entire. Perianth *large*, 4–5·5 mm long, cylindrical, trigonous at the apex, of *2–3 layers of cells from the base to above the middle*, the mouth contracted, crenulate-dentate. Capsule elongate, ovate. Spores 12–15 μ, brownish, papillose. Androecium spicate, median or terminal, bracts in several pairs, imbricate, bilobed, the lobes acute.



1. Fertile plant. 2. Leaves and underleaves on stem. 3. Mouth of perianth. 4. Bracts. 5. Bracteole. 6. Leaf. 7. Cells.

HAB. Among Sphagnum.

DISTRIB. Sussex *(W. E. Nicholson)*; Perthshire *(S. M. Macvicar)*.

. Allied to *C. pleniceps* but differing in the leaves being more longitudinally inserted, and usually more decurrent, less concave, more deeply divided, the sinus generally narrower and with the lobes narrower, more acute and seldom connivent, cells larger, underleaves frequently present; involucral bracts broader and more deeply lobed and with more acute lobes; perianth larger. When the plant grows on rather drier places, as on the surface of Sphagnum, it loses the pale green colour and is more compact, the ♀ inflorescence is on short branches, the leaves more concave and more resembling those of *C. pleniceps*. In this state, it is clearly seen to be monoicous, but in the lax forms of very wet ground, where the ♀ branches become elongated, the monoicous inflorescence is difficult to detect with certainty.

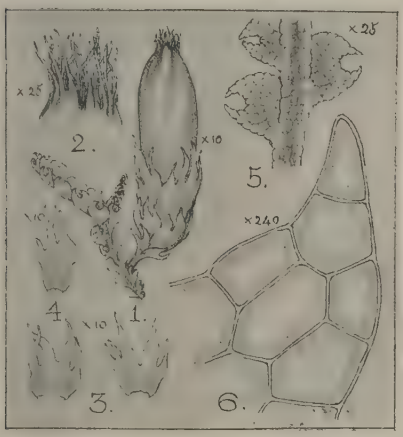
Mr. Nicholson, since publishing this plant, is inclined to regard it as probably a lax southern form, from very wet ground, of *C. pleniceps*, and Herr Müller gives it as a variety of that species when in wet places. This may be the case, but it appears to differ a good deal from the alpine plant.

156. Cephalozia connivens (Dicks.) Lindb.

Jungermannia connivens Dicks., Plant. Crypt. Fasc. 4 p. 19 *pl.* 11 f. 15 (1801); Hook., Brit. Jung. *pl.* 15 (1812).

Cephalozia connivens Lindb. Proc. Linn. Soc. 13 p. 190 (1872); Spruce, On Ceph. p. 46 (1882); Pears., Hep. Brit. Isles p. 157 *pl.* 60 (1900).

Cephalozia multiflora Lindb., Act. Soc. Sc. Fenn. 10 p. 501 (1875); Musc. Scand. p. 4 (1879).



1. Fertile plant. 2. Mouth of perianth. 3. Bracts. 4. Bracteole. 5. Leaves. 6. Cells.

Monoicous. In small pale green patches or creeping among Sphagnum. Stems 5-14 mm long, pellucid, subcompressed, irregularly branched, without flagella; rhizoids somewhat numerous. Leaves very obliquely to *nearly longitudinally inserted*, decreasing in size towards apex and base of stem, horizontal to slightly ascending, obliquely suborbicular, the antical margin *strongly decurrent*, $\frac{1}{3}$ to nearly $\frac{1}{2}$ bilobed, sinus lunate or sometimes only obtuse, *lobes triangular-acuminate*, *connivent*, acute or subacute, *most commonly ending in two single cells* or sometimes in a single cell; cells *large*, *40–60* μ, polygonal, walls thin, trigones absent; cuticle smooth. Underleaves absent. ♀ inflorescence on a short postical branch. Involucral bracts about twice as large as the leaves, *subpalmately* $\frac{2}{3}$*-divided into 3-5 lanceolate-subulate*, *entire segments;* bracteole deeply bifid with a tooth on one or both sides. Perianth cylindrical below, trigonous above, the mouth contracted, *longly ciliate*, the cilia 3–5 cells long. Capsule oblong-oval, reddish-brown. Spores 13–15 μ, pale reddish-brown, thickly papillose; elaters bispiral, claret-coloured. Androecium at the middle or end of the branches, bracts smaller than the leaves, concave, $\frac{1}{2}$ bilobed, the antical margin with an inflexed tooth.

Hab. In bogs and marshes, peat-mosses, sides of streams and wet banks and on stumps, seldom on wet rocks.

Distrib. N. to Shetland, uncommon; Ireland. Fr. Mar.–June.

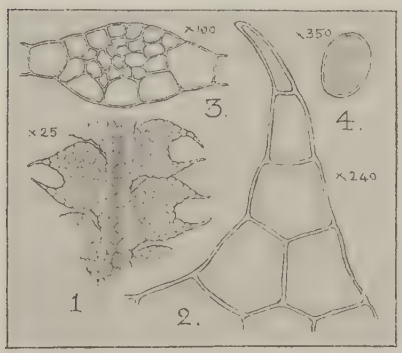
This species can be distinguished either by the palmately lobed bracts, or by the long cilia at the mouth of the perianth; when sterile the large cells will distinguish it from any other of the group except *C. hibernica*. There are a few

spinous teeth between the cilia of the perianth mouth. Characteristic leaves are nearly flat and longitudinally inserted, longly decurrent, sinus broad and with incurved lobes, but not unfrequently the leaves are subsecund, slightly concave, sinus hardly more than obtuse and the lobes slightly incurved or nearly straight. As in many other species, the leaves are less decurrent when imbricate than when distant.

C. compacta Warnst., Krypt. Fl. Mark Brand. p. 217, 1902, resembles in appearance small, compact forms of *C. connivens*. It is monoicous and has the large leaf-cells, 40–50 μ, of this species, but the bracts are bilobed and the lobes have several large teeth; the mouth of the perianth is also less longly ciliate. It is found in similar habitats to those of *C. connivens*, and should be looked for in this country.

157. Cephalozia hibernica Spruce MS. Pears.

Cephalozia hibernica Spruce MS. Pears. in Irish Nat., 3 p. 296 (1894); Pears., Hep. Brit. Isles p. 155 *pl.* 59 (1900).



1. Part of stem with leaves. 2. Cells. 3. Section of stem. 4. Gemma.

Dioicous. Creeping over and among mosses as scattered stems, whitish-green, with a frosted appearance. Stems 5–11 mm long, pellucid, plano-convex, antical layer of cells 3 in number, large, postical layer 5–6, smaller, sparingly and irregularly branched, without flagella, branches frequently long, divaricate, complanate; rhizoids long, rather scarce. Leaves *nearly longitudinally inserted*, decreasing in size towards apex and base of stem, horizontal to slightly ascending, *nearly flat*, antical margin *very strongly decurrent*, obliquely broadly ovate, $\frac{1}{3}$ bilobed, *sinus nearly circular*, *lobes subulate*, *connivent*, ending in 2–4 (*generally 3*) single cells; cells 42–60 μ, polygonal, walls thin, trigones absent; cuticle smooth. Underleaves absent. ♀ inflorescence on short postical branches. Involucral bracts oblong, $\frac{2}{3}$ bifid into lanceolate-acuminate, entire segments; bracteole oblong, bifid to about the middle with a tooth at the side, or entire. Mouth of perianth (immature) with 12–15 long cilia, each of 3–4 single cells. Androecium on the end of a short postical branch, bracts in 4–5 pairs, imbricate, complicate-concave, $\frac{1}{3}$ bilobed, lobes broad, ovate, acute. Gemmae in clusters at the apex of the stem and branches, oblong, colourless.

HAB. On moist banks among mosses.

DISTRIB. Killarney, very rare.

The leaf-lobes are narrower at the base than in *C. connivens*, and terminate in long points composed of generally three single cells, occasionally four, seldom only two. In *C. connivens* the lobes terminate most commonly in two single cells, occasionally in one, but rarely if ever in three; the two species are quite easy to separate, apart from the different inflorescence. Both have a pitted appearance when dry, but this is more noticeable in *C. hibernica*. The only other species with which it could possibly be mistaken is *C. media*, but the apex of the leaf-lobes will at once distinguish them, as well as the different size of cells.

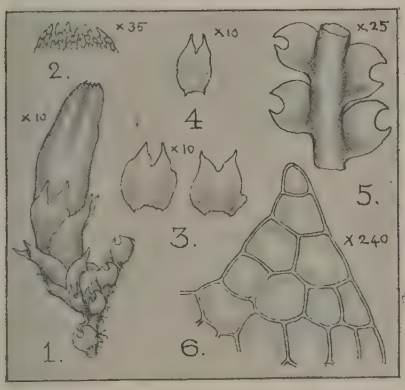
On the smaller branches the leaves are frequently narrower, and $\frac{1}{2}$–$\frac{2}{3}$ divided into long straight segments.

The postical cortical cells of the stem in transverse section are about half the size, or less, of the antical cortical cells as in *C. connivens*; the cortical cells are 9–11 in number, while in *C. connivens* they are 12–14. The stem is usually 5–6 cells deep instead of 7 cells deep in the other, and the internal cells are fewer in number; some of the inner cells are about the same size, or slightly less, than those of the postical layers, and three or four of the cells are much smaller. The internal cells have rather thicker walls that the cortical. The antical side of stem is not quite flat, though more so than in *C. connivens*.

I have not seen the ♀ inflorescence, the description of which is taken from Pearson's *Hep. Brit. Isles*.

158. Cephalozia media Lindb.

Jungermannia connivens forma *symbolica* Gottsche in Gott. and Rabh. Hep. Eur. exs. no. 624 (1877).
Cephalozia media Lindb., Medd. Soc. F. Fl. Fenn. 6 p. 242 (1881).
Cephalozia multiflora Spruce, On Ceph. p. 37 (1882).
Cephalozia symbolica Breidl., Die Leb. Steiermark. p. 330 (1893).
Cephalozia lunulaefolia Pears., Hep. Brit. Isles p. 147 (1901).



1. Fertile plant. 2. Mouth of perianth. 3. Bracts. 4. Bracteole. 5. Leaves. 6. Cells.

Dioicous. In compact dark green to yellowish-green patches, or creeping among *Sphagnum*. Stems 1–2 cm long, prostrate with the apex ascending, sparingly branched, without flagella; rhizoids rather scarce, long and colourless. Leaves subimbricate to approximate, on the sterile stems rather distant, obliquely inserted, ascending, slightly concave, somewhat antically secund, rotund-ovate, the antical margin rather longly to shortly decurrent, $\frac{1}{3}$ *bilobed*, the sinus lunate to obtuse, *the*

lobes connivent or incurved, acute, the apex ending in two, less frequently one single cell; cells 23–30 μ, seldom to 35 μ, polygonal, the walls slightly and equally thickened; cuticle smooth. Underleaves absent. ♀ inflorescence on a short postical branch. Involucral bracts larger than the leaves, oblong-rotund, $\frac{1}{3}$ *bilobed*, seldom 3-lobed, *margin entire*, generally with an obtuse tooth on one side, the sinus obtuse to subacute, the lobes acute, entire; bracteole resembling the bracts, but narrower, frequently connate on one side with the bract, the margins entire. Perianth subfusiform, trigonous at the apex, of three layers of cells at the base and *two layers to above the middle*, sometimes of only one layer to near the base, the mouth somewhat contracted, crenulate-denticulate, the teeth 1, seldom 2 cells long. Capsule oblong-oval. Spores 10–12 μ, reddish-brown, finely papillose; elaters 7–8 μ broad, bispiral, reddish-brown. Androecium at the end or middle of the branches; bracts in several pairs, closely imbricate, nearly resembling the leaves, very concave, the antical margin usually with an inflexed tooth; antheridia oblong-oval, single. Gemmae at the apex of the stem in pale greenish-white clusters, oblong to pyriform, frequently angled and sometimes stellate, 1-celled.

var. **pallida** (Spruce) Massal., Le spec. gen. Ceph. in Malpighia 21 p. 18 (1907).

Cephalozia catenulata var. *pallida* Spruce, on Ceph. p. 33 (1882).
Cephalozia media var. *compacta* Schiffn., Lotos p. 336 (1900)?
Cephalozia pallida Pears., Hep. Brit. Isles p. 146 (1901).

Smaller, leaves imbricate, more concave, less decurrent, sinus frequently deeper and only obtuse, lobes more often less connivent and ending in one single cell; cells commonly 20–28 μ, with the walls rather more thickened; perianth of one layer of cells except at base.

var. **laxa** Schiffn. in Lotos no. 7 p. 336 (1900).

Creeping among Sphagnum. Stems to *3 cm long*, translucent, very sparingly branched. Leaves rather more distant, *larger*, *longly decurrent*, rhombic-rotund on the larger stems; cell-walls with trigones frequently distinct.

Hab. On soil on moist, shaded, peaty or sandy banks and on decaying wood, seldom ascending above 1000 ft. alt.

Distrib. N. to Orkney, frequent; Ireland. Fr. April–August.

Sterile plants of this species can be distinguished from *C. connivens*, *C. pleniceps* and *C. macrantha* by the much smaller leaf-cells, also from the

latter two by the absence of flagella. The dioicous inflorescence will also separate the present species from any of them, and the bracts and mouth of perianth of *C. connivens* are quite different.

C. media varies considerably in appearance, the small compact form of banks being unlike the generally laxer plant of decaying wood and the still laxer plant from among Sphagnum. The var. *pallida* is doubtfully distinct from some of the small forms. All its characters, with the possible exception of the one-layered perianth, can be seen in the others. A specimen from one of the English localities given by Spruce in his "On. Ceph." p. 34 hardly differs from *C. media*. He also quotes No. 173 of G. and R. Hep. Eur. Exs., but this plant does not differ from small forms of *C. media*. His other reference, to No. 269 of the same collection, seems to be a misprint, as the specimen is not a *Cephalozia*. Müller, who has also examined the specimen from the English locality referred to above, reduces *C. pallida* to a synonym of *C. media*.

Var. *elata* Spruce, "On Ceph." p. 38 is *C. macrostachya*.

Müller describes the Continental *C. affinis* Lindb. as being closely related to *C. media*, differing from it in the leaves being less deeply bilobed, cells larger, 30–40 μ, the mouth of perianth with teeth composed of 2–3 single cells and the monoicous inflorescence; it is found on decaying wood and should be looked for in Britain.

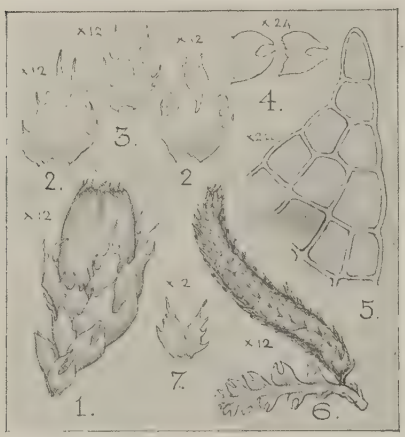
It has been a vexed question for some time what name *C. media* should bear. The older authors did not distinguish it from *C. connivens*, but Spruce believed that Dumortier had given it the name of *C. lunulaefolia*. In a note in Pearson's "Hep. Brit. Isles" p. 149, Spruce mentions having seen two of Dumortier's specimens, one of which was distributed in Mougeot and Nestler's Exs., and he considered that it represented the plant under consideration. He does not mention the number of the specimen in the Exsiccata, but Dumortier quotes no. 432 as a synonym of his *C. lunulaefolia* in "Hep. Eur." p. 92, 1874. This number is apparently composed of more than one species, as Müller considers that the specimen which he examined is *C. serriflora*. The doubt whether *C. lunulaefolia* is the present species is increased by Dumortier's description of it in "Hep. Eur." as having straight leaf-lobes and dentate bracts. This might suit *C. serriflora*, but certainly does not agree with *C. media*. Under the circumstances it seems preferable to give the plant the now almost generally accepted name of *C. media* Lindb., of the meaning of which there is no doubt.

159. Cephalozia macrostachya Kaal.

Cephalozia macrostachya Kaal., Rev. Bryol. p. 8 (1902); Steph., Spec. Hep. III p. 297 (1908); Nicholson, Hast. and East Sussex Nat. 1, 6 p. 274 (1911).
Cephalozia multiflora var. *elata* Spruce, On Ceph. p. 38 (1882).

Dioicous. In rather dense to thin, yellowish-green to dark green patches among Sphagnum. Stems 10–12 mm long, ascending throughout or only at the apex, *strongly flexuous*, sparingly branched, without flagella; rhizoids long, colourless, numerous where the stem is flexuous, absent or scarce elsewhere. Leaves *rather distant* to approximate, slightly concave, obliquely inserted, somewhat antically secund, shortly decurrent, rotund-quadrate to oval-rotund, the postical margin *frequently strongly arched*, ½ bilobed, the sinus subacute to lunate, the lobes somewhat unequal, slightly connivent or *frequently nearly straight*, acute, the apex ending in two single cells;

cells 23–30 μ, sometimes to 35 μ, quadrate-hexagonal, pellucid, the walls slightly and nearly equally thickened; cuticle smooth. Underleaves absent or seldom a few present, minute. ♀ inflorescence on a short postical branch. Involucral bracts broadly ovate to ovate-quadrate, $\frac{1}{2}$ bilobed, the margins more or less *spinous-dentate*, the sinus *acute*, *narrow*, the lobes lanceolate, acuminate, *spinous-dentate* or entire; bracteole deeply and irregularly 2–3-lobed, *spinous-dentate*. Perianth oblong-ovate, of one layer of cells except at the base, trigonous, the mouth somewhat contracted, *ciliate*, the cilia 3–4 cells long. *Androecia very large*, terminal or median, sometimes occupying the entire branch; bracts in 6–14 pairs larger than the leaves, imbricate, erect, transversely inserted, acutely bilobed to below the middle, the lobes elongate and narrowly lanceolate, *dentate* to *spinous-dentate;* antheridia oval, single. *Gemmae in globose heads* at the apex of the stem, rounded-oblong, sometimes pyriform or angular, greenish-white, 1-celled.



1. Fertile plant. 2. Bracts. 3. Bracteole. 4. Leaves. 5. Cells. 6. Male inflorescence. 7. Male bract.

HAB. Among Sphagnum in bogs.

DISTRIB. N. to Forfar, rare?

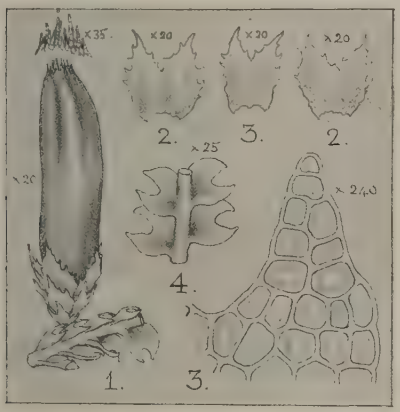
The large androecia with their spinous-dentate bracts, will at once distinguish this species. Plants without inflorescence are more likely to be mistaken for a large form of *C. media* than any other, but the present species has the leaves rather more deeply lobed and with the lobes often nearly parallel and the postical margins frequently strongly arched, the apex of the lobes also usually ends in two single cells, while in the other it frequently ends in a single cell; the involucral bracts are very different in the two species. *C. connivens* has much larger leaf-cells. *C. serriflora* is smaller and with smaller cells.

A specimen of *C. multiflora* var. *elata* Spruce, sent to me from the original locality by Stabler, is *C. macrostachya*. In the *Naturalist* p. 233, 1898, Stabler quotes in the notes to the var. *elata* "'♂ flowers often in little globose heads at the apex of the branches' Spruce in litt." This is evidently an oversight, the globose heads being gemmae; they are larger and more conspicuous than the clusters of gemmae in *C. media*.

This species is widely distributed in Britain, and, when better known, may be found to be not very rare.

160. Cephalozia serriflora Lindb.

Jungermannia reclusa Tayl. p.p. ?, Journ. Bot. p. 278 (1846).
Cephalozia reclusa Dum. p.p. ?, Hep. Eur. p. 92 (1874).
Cephalozia serriflora Lindb., Medd. Soc. F. Fl. Fenn. 3 p. 188 (1878).
Cephalozia catenulata Spruce p.p., On Ceph. p. 33 (1882).



1. Fertile plant, with mouth of perianth enlarged. 2. Bracts. 3. Bracteole. 4. Leaves. 3 (bis) Cells.

Dioicous. In thin *pale brown* or fuscous patches, *usually on decaying logs*. Stems 4–8 mm long, rigid when dry, prostrate, irregularly branched, without flagella, branches long, ascending; rhizoids long, rather scarce to near apex of stem. Leaves *obliquely* inserted, subimbricate to imbricate, ascending, somewhat antically secund, slightly concave, the antical margin not or *hardly decurrent*, *broadly ovate-oval*, narrowed at the base, $\frac{1}{2}$ *bilobed*, sinus obtuse or rounded, lobes 4–6 (commonly 5) cells broad at base, triangular, acute, slightly connivent or straight, when dry *incurved*; cells *small*, *16–21* μ, slightly larger at the base, quadrate to oblong-quadrate, *walls considerably and equally thickened*; cuticle smooth. Underleaves absent. ♀ inflorescence on a very short postical branch. Involucral bracts twice as large as the leaves, more or less connate, $\frac{1}{3}$ bilobed, frequently with a third shorter acute lobe, sinus acute, the margin except at base *distantly spinous-dentate or serrate-dentate*, the lobes triangular, acute or acuminate, spinous-dentate or entire; bracteole resembling the bracts. Perianth oblong, obtusely trigonous *along its whole length*, of one layer of cells throughout, the mouth contracted, *setulose or subciliate*, cilia 1–3 cells long. Capsule oval. Spores 9–12 μ, finely papillose; elaters reddish-brown. Androecia at the end of the branches; bracts in few pairs, imbricate, of the same size as the leaves, concave, bilobed, with a antical tooth. Gemmae in clusters at the apex of the stem and branches, rotund or oblong, rarely angular, colourless, 1-celled.

Hab. On decaying wood in moist, sheltered places, seldom on sandstone rocks.

Distrib. N. to Inverness, rare; Ireland. Fr. April–June.

The fulvous or pale brown colour, the leaves practically not decurrent, divided to the middle, and with smaller cells which have more thickened walls, separate the sterile plant from small forms of *C. media*; when the lobes are connivent the sinus is narrower than in that species. The bracts are always dentate, but this varies in amount; the lobes are sharply triangular, and frequently dentate or spinous-dentate, as are also the margins below the sinus; they have no resemblance to the bracts of *C. media*.

C. leucantha has distant, paler and more pellucid leaves which are also more quadrate, more transverse, lobes narrower and more acute, cells smaller; the perianth is also much longer and is cylindrical in the lower half.

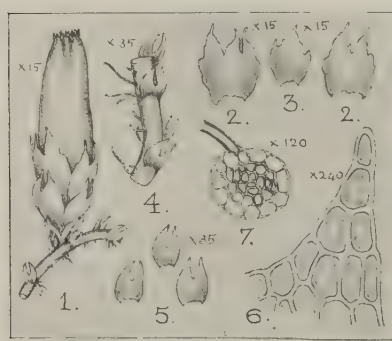
This species is almost but not entirely confined to decaying logs and stumps.

Spruce considered that *Jung. catenulata* Hüben., "Hep. Germ.," p. 169, 1834 was the same species as the present plant, but most writers now hold them to be distinct. Hübener describes the margins of the bracts as being quite entire, and the plant as occurring on moist turfy soil. In addition to the entire bracts and the plant rarely occurring on decaying wood, *C. catenulata* is stated to differ in having rather larger leaf-cells, 20–25 μ, the leaves rather narrower and with a narrower sinus, and more directed towards the apex of the stem. Jack states in "Lebermoosstud. in Baden" *(Mitt. Bad. bot. Ver.* p. 5 reprint, 1900) that *C. catenulata*, as distinct from *C. serriflora*, occurs in Britain, being represented in Carr. and Pears. "Hep. Brit. Exs." nos. 215 and 216, but according to my examination, no. 215 is *C. media* and no. 216 is *C. serriflora*. The latter has the margin of the bracts distinctly dentate. It is probable that Jack examined an impoverished plant. *C. catenulata* appears to be a rare species which seldom has perianths, but it will probably be found in Britain.

Taylor had evidently a vague idea of his *Jung. reclusa*, judging from the various species to which he gave this name, and he does not mention the characteristic bracts in the original description. It seems best, therefore, to use Lindberg's name for the plant.

161. Cephalozia leucantha Spruce

Cephalozia leucantha Spruce, On Ceph. p. 68 (1882); Evans, Proc. Wash. Acad. Sci. 2 p. 306 *pl.* 17 f. 18–26 (1900).



1. Fertile plant. 2. Bracts. 3. Bracteole. 4. Leaves on stem. 5. Leaves. 6. Cells. 7. Section of stem.

Dioicous. In pale *whitish*-green patches or creeping among mosses. Stems to 10 mm long, slender, flexuous and arcuate, without flagella, irregularly and shortly branched, frequently nearly simple; rhizoids scattered, short, to near apex of stem. Leaves small, equalling in length the diameter of the stem or slightly longer, *distant*, patent to erecto-patent, *nearly transversely* inserted, with the antical margin not decurrent, *oblong-quadrate*, bilobed to or

beyond the middle, sinus obtuse or subacute, *lobes frequently unequal*, 3–4 cells broad at base, *broadly subulate*, acute or acuminate, *parallel or connivent;* cells *small*, *12–18* μ, quadrate to oblong-quadrate, hardly larger at the base, hyaline, walls considerably and equally thickened; cuticle hyaline-papillose. Underleaves absent. ♀ inflorescence on a very short postical branch. Involucral bracts 3–4 times as large as the leaves, more or less connate, *rotund-ovate*, subdenticulate or sinuate-dentate, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, occasionally irregularly 3-lobed, sinus acute or obtuse, lobes longly acuminate; bracteole irregularly bilobed. *Perianth very long*, *white*, narrowly cylindrical-fusiform, trigonous above, the mouth small, setulose, setae 1–2 cells long. Capsule oblong-oval, yellowish-brown. Spores 9–12 μ, yellowish-brown, minutely papillose; elaters reddish-brown, laxly bispiral. Androecium terminal, *subjulaceous*, bracts closely imbricate, larger than the leaves, very concave, orbicular, $\frac{1}{3}$ bilobed, the lobes incurved, the antical margin with a small tooth. Antheridia large, oval-globose, shortly pedicellate.

Hab. In peat-mosses and on peaty soil or banks and sides of ditches, and on decaying wood, subalpine ascending to 1900 ft. alt.

Distrib. Yorkshire? and Dumfries to Shetland, frequent; Ireland. Fr. April–June.

The white, bleached colour, and the remote and nearly transverse small leaves with small cells distinguish this species; the small cells will alone separate it from any small forms of *C. media* or *C. bicuspidata*, with which it is sometimes confused.

The leaf-sinus is narrow, so that when the lobes are connivent they enclose an oval or elliptic space, not an almost circular one as in the previous species with connivent lobes; the lobes are most commonly nearly parallel in this species and even occasionally somewhat divergent.

The involucral bracts are rotundate, the margins with remote and obtuse teeth over the whole surface, or sinuate-entire in the lower half and sharply dentate above; the lobes are entire or slightly dentate; the bracteole has sometimes a large lobe at the side, instead of being bilobed.

This species is most frequently found with us on moist peaty ground; it is rather uncommon on decaying logs. The small, nearly transverse leaves bring it to a certain extent near *Cephaloziella*.

Subgen. **Cladopus** Spruce

Cladopus Spruce, On Ceph. p. 49 (1882); K. Müll., Rabh. Krypt. Fl. II p. 16 (1912).

Eucephalozia sect. *Subluridae* Spruce, loc. cit. (1882).

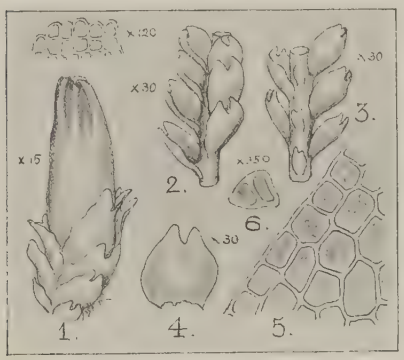
Eucephalozia (gen.) subgen. *Cladopus* Schiffn. in Engl. and Prantl 1. 3 p. 97 (1895).

Cortical layer of cells of stem not pellucid; flagella numerous. Leaves $\frac{1}{5}$–$\frac{1}{4}$ bilobed, with obtuse lobes. Underleaves distinct on the stem.

162. Cephalozia Francisci (Hook.) Dum.

Jungermannia Francisci Hook., Brit. Jung. *pl.* 49 (1813); G. L. N., Syn. Hep. p. 133 (1844).

Cephalozia Francisci Dum., Rec. d'obs. p. 18 (1835); Spruce, On Ceph. p. 49 (1882).



1. Fertile plant, with mouth of perianth enlarged. 2. Stem, antical view. 3. Do., postical. 4. Leaf. 5. Cells. 6. Gemma.

Dioicous. *Small.* In low, usually compact, *reddish* or green patches. Stems 5–8 mm long, filiform but succulent, pale, *creeping and leafless below with flagella*, with several erect or ascending branches which are also frequently leafless at the base; rhizoids colourless, numerous on the lower part of stem and flagella, scarce to almost absent above. Leaves subimbricate to imbricate, ascending, subsecund, obliquely inserted, *concave*, the antical margin *not decurrent*, broadly ovate to ovate-oval, $\frac{1}{6}$–$\frac{1}{5}$ *bilobed*, sinus *narrow*, acute or obtuse, lobes obtuse or more rarely subacute, *incurved*; cells *small*, 17–23 μ, *quadrate-rotund* to polygonal, subopaque, the *walls strongly and nearly equally thickened*, frequently vinous-red; cuticle finely granulate. *Underleaves large*, nearly appressed to erecto-patent, *oblong* to lanceolate, entire or shortly bidentate. ♀ inflorescence on short postical branches, denudate at base. Involucral bracts large, loosely surrounding the perianth at the apex and somewhat crispate, oblong-oval, $\frac{1}{3}$ bilobed, sinus narrow and acute, *lobes ovate-oval*, *obtuse*, margins with an obtuse lobe or tooth on one or both sides, or entire; bracteole resembling the bracts. Perianth oblong-fusiform, thickened at the base, obtusely trigonous below, 4–6-angled and plicate above, the mouth *hyaline*, *irregularly lobate*, the lobes crenulate. Capsule oval, brown. Spores 12–15 μ, papillose, brown. Androecium at the end of short postical branches or on the middle of the lower branches, bracts in 4–6 pairs, transverse, very concave, closely imbricate. Antheridia globose, solitary, rotund. Gemmae colourless or vinous-red, in clusters at the apex of the branches and occasionally on the underleaves, *mostly 3-angled* with a few oblong or elliptical, 1–2-celled.

HAB. Moist peaty banks and ditches.

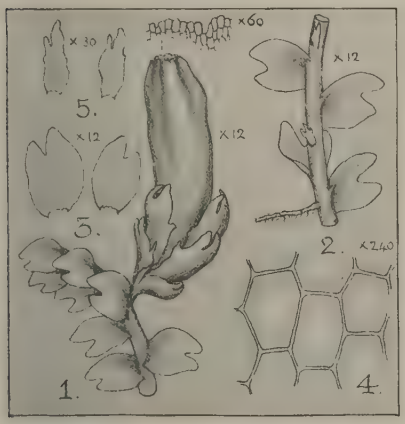
DISTRIB. N. to Ross, rare; Ireland. Fr. June–July.

The flagelliferous stems, with the concave leaves having a short, narrow sinus, and the large underleaves will distinguish this species. It is a small plant, but frequently forms large patches on subalpine banks. In exposed ground it is reddish and attracts the eye by its colour. When the leaf is flattened out, the sinus is like a small notch. The perianth is commonly vinous-red in the middle, with the apex hyaline. The triangular gemmae are unlike those of our other species of the genus.

Mr. Nicholson has found in Surrey a lax and somewhat elongate form among Sphagnum.

163. Cephalozia fluitans (Nees) Spruce

Jungermannia fluitans Nees in Syll. Ratisb. p. 129 (1823).
Jungermannia inflata δ *fluitans* Nees, Eur. Leb. II p. 43 (1836).
Cephalozia obtusiloba Lindb., Bot. Notis. p. 164 (1872).
Cephalozia fluitans Spruce, On Ceph. p. 50 (1882).
Lophozia inflata subsp. *Loph. fluitans* Boulay, Musc. de la France II p. 104 (1904).



1. Fertile plant with mouth of perianth enlarged. 2. Stem, postical view. 3. Leaves. 4. Cells. 5. Underleaves.

Dioicous. In rather large swollen tufts *submerged in pools on moors*, or as more or less scattered stems creeping among Sphagnum, green to lurid-brown in colour. Stems 3–5 cm long, rarely to 8 cm, simple or sparingly branched, with leafless or scattered small-leaved *flagella*; cortical cells 14–15 in number, opaque, slightly larger than the pellucid inner cells; rhizoids rather numerous below and on the flagella, scarce to nearly absent above, colourless. Leaves flaccid, *distant*, more rarely subimbricate, horizontal and most frequently reflexed, sometimes ascending and subsecund, obliquely inserted with the antical margin *not decurrent*, *oval-oblong*, $\frac{1}{5}$–$\frac{1}{3}$ *inciso-bilobed*, *sinus narrow*, acute or rounded at the base, lobes ovate, *obtuse or rounded*, unequal, the postical larger;

cells *large*, 35–42 μ, with some to 56 μ, larger at the base, 5–6-angled, the marginal cells smaller and subquadrate, walls slightly and nearly equally thickened; cuticle smooth. *Underleaves always present*, appressed or nearly so to the stem, remote, small, *linear-subulate*, the apex frequently bidentate. ♀ *inflorescence on short postical branches*. Involucral bracts about twice as large as the leaves, canaliculate-concave, narrowly oblong, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, with a long tooth at the middle of one or both margins, the sinus very narrow and acute, lobes lanceolate, acute or subobtuse; bracteole resembling the bracts. Perianth *longly exserted*, 3–4 mm long, *narrowly oblong-cylindrical*, 3–4 cells thick at the base and 2–3 cells thick to the middle, cylindrical below, obtusely trigonous above, the mouth somewhat constricted, lobulate and crenulate. Capsule oblong-cylindrical, 1 mm long, dark brown, the pedicel long and stout, inner layer of wall with numerous semi-annular thickenings. Spores 15–18 μ, dark purple, minutely and closely asperous; elaters 120–200 μ by 7–9 broad, of the same colour, bispiral. Androecium on short postical branches or at the middle or apex of the stem, bracts in 5–10 pairs, transverse, imbricate, resembling the leaves but rounder, complicate-concave and with an antical tooth. Antheridia solitary.

var. **gigantea** Lindb.

In large, swollen tufts, *15–20 cm long*, submerged in pools. Leaves more distant, larger than the type, *cells larger*.

Hab. In bogs and pools on moors and creeping among wet Sphagnum, ascending to 1200 ft. alt.

Distrib. N. to Caithness, uncommon; Ireland. Fr. May–June. Var. *gigantea*, Abbot's Moss, Cheshire, 1887 *(G. A. Holt.)*

Closely resembles *Gymnocolea inflata* in appearance and is often confused with it; it can be readily distinguished from that plant in the sterile state by the presence of flagella and by the much larger leaf-cells. The *Gymnocolea* has very frequently perianths present, these being at the apex of the stem, obovate and very caducous, and quite different from the cladogenous linear-oblong perianths of the *Cephalozia*. Although perianths are rare in *C. fluitans*, the ♀ inflorescence on its short postical branches is not uncommon, and at once distinguishes it. The position of the ♂ inflorescence is of less value as a character, it being not at all rarely at the apex or middle of the stem.

Cephalozia fluitans is always in very wet ground, either for the most part submerged or as scattered stems among Sphagnum in places where there is much permanent moisture.

After the exsertion of the capsule, the perianth is almost cylindrical.

Submerged forms, which are somewhat elongate, are not uncommon, but the var. *gigantea* is very rare.

XLI. NOWELLIA Mitt.

Cephalozia Dum., Rec. d'obs. p. 18 (1835).

Nowellia Mitt. in Godman's Nat. Hist. Azores p. 321 (1870); Schiffn. in Engl. and Prantl, Nat. Pflanz. I 3 p. 97 (1895); Steph., Spec. Hep. III p. 347 (1908).

Plants small, green or rosy, closely creeping; branches usually few, postical; flagella absent. Leaves inserted with a very narrow and almost transverse base, antical margin nearly straight, postical margin broadly semicordate at the base, *inflexed and saccate, forming a lobule, lobes ending in two long capillary-hamate segments.* Inflorescence as in *Cephalozia.* Perianth with a wide mouth.

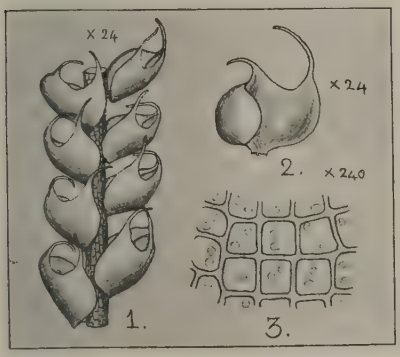
This genus, of which three species are at present known, was named by Mitten after the Yorkshire botanist John Nowell. Immature leaves occasionally do not show their distinctive characters, but this does not detract from their generic value.

164. Nowellia curvifolia (Dicks.) Mitt.

Jungermannia curvifolia Dicks., Plant. Crypt. Fasc. 2 p. 15 *pl.* 5 f. 7 (1790); Hook., Brit. Jung. *pl.* 16 f. 4–5 (1812) et Suppl., *pl.* 1 (1816).

Cephalozia curvifolia Dum., Rec. d'obs. p. 18 (1835); Spruce, On Ceph. p. 47 (1882).

Nowellia curvifolia Mitt. in Godman's Nat. Hist. Azores p. 321 (1870).



1. Stem, antical view. 2. Leaf. 3. Cells.

Monoicous and dioicous. In flat *rosy-purple* or green patches, usually on *decaying trunks of trees.* Stems 10–18 mm long, slender, pellucid, flexuous, nearly simple, the few branches ascending; rhizoids long, colourless, scattered, to apex of stem. Leaves rather laxly imbricate, antically secund, ascending, *very concave, almost transversely inserted with a narrow base,* obliquely obovate, the antical margin slightly curved, not decurrent, the postical margin semi-cordate at the base with the margin *broadly incurved, sacculate,* bilobed to beyond the middle, sinus broad, usually lunulate,

lobes triangular at base, ending in *long incurved capillary segments* composed of a single series of 8–10 cells; cells 17–24 μ, *subquadrate* to quadrate-hexagonal, the walls strongly and sub-equally thickened; cuticle smooth. Underleaves absent. ♀ inflorescence on a short postical branch. Involucral bracts large, oblong-oval, conduplicate and *channelled*, with the margins reflexed in the upper part, free or slightly connate at the base, $\frac{1}{3}$ bilobed, lobes sharply acuminate, *spinous-ciliate to dentate-serrate*; bracteole nearly similar to the bracts. Perianth large, oblong, deeply trigonous, *the mouth broad*, truncate, *spinous-ciliate*, the cilia 3–4 cells long. Capsule broadly oval, reddish-brown. Spores 7–9 μ, pale yellowish-brown, minutely papillose; elaters long, laxly bispiral, reddish-brown. Androecium at the apex of short branches; bracts in 4–6 pairs, imbricate, conduplicate, bilobed, resembling the leaves but more symmetrical and with shorter laciniae, the antical margin with a tooth. Antheridia solitary, globose, shortly pedicellate. Gemmae at the apex of the stem, globose-oblong, colourless, 1-celled.

Hab. On decaying wood in moist sheltered places and on moist peat, subalpine, ascending to 1200 ft. alt.

Distrib. Wales to Shetland, uncommon; Ireland. Fr. May–August.

Is not likely to be confused with any other species; the saccate inflexed postical margin of the leaf forms an auricle which is not present in any other of the group; also the capillary, hamate segments of the leaf are distinctive. The plant is green in excessive shade or wet ground, and is rosy-purple when more exposed. It frequently forms extensive patches on decaying trunks, and may be brightly coloured on the upper side of the trunk and green on the shaded parts. The perianth is usually reddish-purple below and hyaline near the mouth. Fruit is common when on wood, but is apparently always absent when on peat. Hooker in *Brit. Jung.* confused other species with his *Jung. curvifolia*. Some of his figures on plate 16 do not belong to this species, and it is not at all an alpine plant in Britain, while he is under the impression that it is "altogether alpine."

XLII. CEPHALOZIELLA (Spruce) Schiffn.

Cephalozia subgen. *Cephaloziella* Spruce, On Ceph. p. 62 (1882).
Cephaloziella Schiffn. in Engl. and Prantl, Die Nat. Pflanz. I 3 p. 98 (1895).

Plants *small or minute*. Stems *without flagella*, branches postical, seldom also lateral. Leaves *slightly or hardly broader than the stem*,

almost *transversely inserted*, channelled, divided to the middle or deeper into two entire or seldom dentate, usually somewhat divaricate lobes; *cells small to very small.* ♀ inflorescence *acrogynous* seldom cladogenous; bracts larger than the leaves, tristichous, generally more or less connate at the base, dentate, seldom entire. Perianth usually elongate and narrow, *3–6-plicate*, seldom only 3-plicate, the mouth constricted, truncate-crenulate or dentate. Pedicel of capsule usually composed of four cells in section.

Cephaloziella is variously given by authors as a genus, or as a subgenus of *Cephalozia*. It differs chiefly from the other in the leaves, the upper ones at least being transversely inserted, by the perianth being mostly 4–6-plicate, and in being generally acrogenous. The species is also commonly smaller, flagella are never present, the leaves are only slightly broader than the stem and the cells are small to minute.

1 { Dioicous 2
  { Monoicous or paroicous 3

2 { Acrocarpous; leaves ½ bilobed, lobes acute, 5–8 cells broad at base ..... *165. byssacea*
  { Cladocarpous; leaves ¾ bilobed, lobes acuminate, the apex frequently incurved, 2–4 cells broad at base ..... *172. aeraria*

3 { Monoicous 4
  { Paroicous 7

4 { Bracts with irregularly rounded, highly connate lobes ..... *168. integerrima*
  { Bracts with acute lobes 5

5 { Leaf-cells 20–25 μ or more; bracts spinous-ciliate ..... *173. elachista*
  { Cells 14–20 μ; bracts entire or dentate 6

6 { Cells 17–20 μ; bracts entire or occasionally subdenticulate *167. Baumgartneri*
  { Cells 14–18 μ; bracts dentate, rarely entire ..... *166. bifida*

7 { Upper leaves patent to squarrose; underleaves well developed; perianths rather uncommon ..... *169. stellulifera*
  { Leaves erecto-patent; underleaves few or none; perianths usually present .. 8

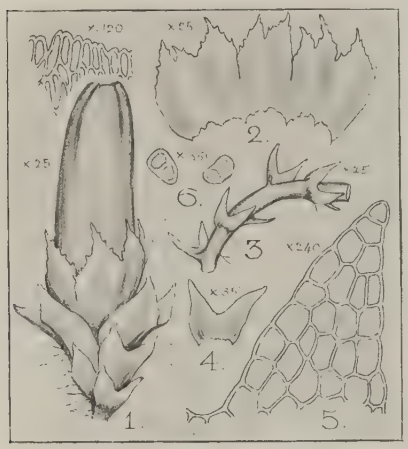
8 { Leaf-cells 12–15 μ with thickened walls: bracts dentate ..... *170. myriantha*
  { Leaf-cells 16–20 μ with thinner walls; bracts entire, with longer and narrower lobes ..... *171. Limprichtii*

165. Cephaloziella byssacea (Roth) Warnst.

Jungermannia byssacea Roth, Fl. Germ. p. 307 (1800).

Jungermannia Starkii Herb. Funck in Nees, Eur. Leb. II p. 225 (1836).

Cephalozia divaricata β Starkii Spruce, On Ceph. p. 64 (1882).
Cephalozia byssacea Heeg, Die Leb. Niederöst. p. 96 (1893).
Cephalozia Starkii Schiffn., Lotos no. 7 p. 341 (1900).
Cephalozia byssacea Warnst., Krypt. Fl. Mark Brand. p. 224 (1902).



1. Fertile plant, with mouth of perianth enlarged. 2. Bracts and bracteole. 3. Sterile stem. 4. Leaf. 5. Cells. 6. Gemmae.

Dioicous. In thin *dark green to purple, sometimes blackish* patches. Stems 3–10 mm long, prostrate or ascending, rigid and brittle, simple or sparingly branched, sometimes innovating from below the ♀ inflorescence; rhizoids rather scarce, colourless, but frequently numerous and long below the inflorescence. Leaves on the sterile stems small and distant, generally widely patent and frequently flat or slightly channelled, on the fertile stems increasing in size and subimbricate towards the apex, erecto-patent to erect, slightly concave or keeled with the apex frequently incurved, subovate-quadrate, divided to the middle or deeper into two ovate-lanceolate, acute or subacute, straight or slightly divergent, entire lobes, the sinus narrow at base, obtuse or acute; cells 12–15 μ, subquadrate, the walls generally only slightly and nearly equally thickened; cuticle smooth, seldom papillose. *Underleaves distinct on both sterile and fertile stems*, lanceolate-subulate with the apex incurved. ♀ inflorescence at the apex of the stem, bracts suddenly much larger than the leaves; involucral bracts bilobed, the lobes acuminate, *acutely dentate to subspinulose, the margin and apex hyaline*, cells strongly incrassate; bracteole bilobed, rather smaller than the bracts and adnate to them at the base on one or both sides. Perianth fusiform, 3–6-plicate, frequently purplish below and hyaline above, the mouth contracted, crenulate. Capsule oval. Spores 7–9 μ, purplish-brown, almost smooth. Elaters 6–8 μ broad, bispiral. Androecia terminal or intercalary, bracts in 6–12 pairs, closely imbricate, rounded-quadrate, concave, ½ bilobed. Antheridia single. Gemmae in yellowish-green to reddish clusters at the apex of the sterile stems, oval, 2-celled.

var. **asperifolia** (Jens.) Macv.

Cephalozia asperifolia C. Jens. (non *Jung. asperifolia* Tayl.), Medd. om Grönland 15 p. 372 (1898).
Cephalozia divaricata var. *scabra* Howe, Hep. and Anthoc. California in Mem. Torr. Bot. Club 7 p. 129 (1899).
Cephalozia asprella Steph., Spec. Hep. III p. 337 (1908).

Cuticle of leaf *distinctly papillose* with small, slightly raised papillae, and with in addition some large conical papillae on the back near the fold; cell-walls *thickened, sometimes greatly so;* margin of leaf sometimes subdenticulate, rarely also at the base slightly spinous-dentate; underleaves more or less denticulate.

HAB. Banks, sides of drains, rocks, etc., ascending to 3900 ft. alt.

DISTRIB. N. to Shetland, rather common; Ireland. Fr. July–Oct. Var. *asperifolia*, Ben Doureinn, Argyll, 1908 *(H. H. Knight)*.

This is the only common species of the genus in Britain. The underleaves are numerous and conspicuous, the margins of the involucral bracts are broadly hyaline, and are irregularly and coarsely dentate to spinulose-dentate. It most generally occurs in dry ground, and in such places is reddish-brown or purplish-brown to almost black; in shaded ground it is green. The size and direction of the leaves vary greatly.

This is doubtless the frequent plant in Britain which Hooker intended by his *Jung. byssacea* in *Brit. Jung.* no. 12, though the underleaves were not observed by him.

The var. *asperifolia* is a well marked plant. Herr Jensen, to whom I sent the Scottish specimen, named it as his *Ceph. asperifolia*. I also sent him a specimen of the var. *scabra* from California, which was sent to me by Dr. Howe; this he likewise determined as his *C. asperifolia*. The British plant is dark purple, growing among *Frullania* on an alpine boulder.

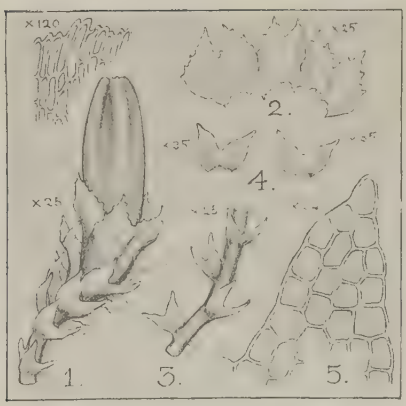
Ceph. papillosa Douin, *Rev. Bryol.* p. 72 1901 and p. 5 1908 (*C. Douini* Schiffn.) appears to be a less distinct plant than *C. asperifolia*. It is green, cell-walls thin, and with abundant gemmae. The spores are also smaller than in *C. byssacea* according to Douin (*Bull. Soc. Bot. France*, p. 248, 1905). Some of the specimens sent to me by him have nearly all the leaves smooth. I have not seen a British specimen which agrees with the most characteristic specimens, though they resemble some of the French plants.

The cuticle of the leaf is not infrequently somewhat roughened in *C. byssacea*, but the small papillae, combined with the large conical ones, of the var. *asperifolia* make the latter a distinct variety, though even in that the leaves are occasionally smooth.

Ceph. divaricata var. *verrucosa Jens.* has been described as a monoicous species, *Ceph. verrucosa* (Jens.) Bryhn and Kaalaas in the Report Sec. Norv. Arct. Exped. in the "Fram," Bryophyta p. 45, 1906.

166. Cephaloziella bifida (Schreb.) Schiffn.

Jungermannia bifida Schreb. in Schmid., Icon. et Anal. Pl. 3 p. 250 (1787).
Jungermannia rubella Limpr., Krypt. Fl. Schles. p. 295 (1876)?
Cephaloziella bifida Schiffn., Lotos no. 7 p. 340 (1900).
Cephaloziella trivialis Schiffn., Lotos no. 7 p. 341 (1900).
Cephaloziella Hampeana (Nees) Schiffn., Oest. Bot. Zeit. p. 6 reprint (190).



1. Fertile plant, with mouth of perianth enlarged. 2. Bracts and bracteole. 3. Sterile stem. 4. Leaves. 5. Cells.

Monoicous. In thin, generally *reddish-brown*, seldom green patches. Stems 3–8, occasionally to 10 mm long, flexuous, rigid, prostrate, sparingly branched, frequently innovating from below the ♀ inflorescence; rhizoids long and colourless. Leaves on the sterile stems about as broad as or slightly broader than the stem, distant, patent to erecto-patent, slightly concave, oblong-cuneate, divided to below the middle into two lanceolate, acute, divergent lobes, 5–8, seldom 4 cells broad at base, the sinus acute; leaves on the fertile stems larger, subimbricate, *erecto-patent to suberect*, concave, roundish-quadrate, $\frac{1}{2}$ bilobed, the lobes *subacute*, entire; cells 14–18 μ, subquadrate, the walls frequently rather strongly and equally thickened; cuticle smooth or nearly so. Underleaves *absent*, rarely a few present especially near the apex of the sterile stems. ♀ inflorescence at the end of the stem or elongated branches; bracts larger than the leaves; involucral bracts $\frac{1}{3}$ bilobed, the lobes acute, *crenulate-dentate* to dentate, seldom entire, *the margin concolorous*, *the apex seldom hyaline*; bracteole rather smaller than the bracts and adnate to them for some distance above the base on both sides, bilobed, the lobes crenulate to denticulate. Perianth linear-oblong, 3–6-plicate, reddish-brown below, the upper part hyaline, the mouth crenulate-dentate with elongated cells. Androecia terminal or intercalary on long branches, bracts in 6–10 pairs, larger than the leaves, closely imbricate, very concave, $\frac{1}{3}$ bilobed, the lobes apiculate or acute, entire. Antheridia oval, single.

HAB. Sandy and turfy ground, stumps, and occasionally in bogs and peat-mosses.

DISTRIB. N. to Caithness, frequent; Ireland?

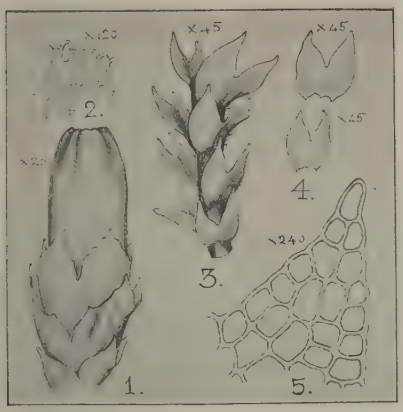
There is a good deal of uncertainty at present regarding the name this plant should bear. It is monoicous, the leaves on the sterile stems 5–8, seldom only 4 cells broad at base, generally somewhat broader than the stem. The cell-walls are considerably thickened when the plant is on dry ground, but when in bogs they are thin. I include *C. trivialis* Schiffn. as a form or variety of wet ground; it is usually green with more acute leaf-lobes and with thin walls. Underleaves

are generally absent in this species but rarely they are present both in the plant of bogs and of drier ground. *C. Curnowii* (Slater) Macv., a description of which has not been published, appears to be one of the forms having underleaves.

C. byssacea, the only other frequent species, is dioicous, underleaves are always present and usually numerous, the bracts are broadly hyaline and more dentate. *C. Baumgartneri* has larger leaf-cells, and the bracts frequently with entire lobes; also it is calcicolous.

167. Cephaloziella Baumgartneri Schiffn.

Cephaloziella Baumgartneri Schiffn., Verh. k. k. Zool. Bot. Ges. Wien p. 273 *pl.* 1 fig. 7–19 (1906); Nicholson, Hast. and East Suss. Nat. 1, 6 p. 281 (1911).
Cephalozia Baumgartneri Massal., Spec. Ital. Gen. Ceph. in Malpighia 21 p. 33 (1907).
Cephalozia patula Steph. in Lev., Bull. Soc. Bot. Ital. p. 210 (1905)?
Cephaloziella patula Nicholson, Journ. Bot. p. 279 (1907).



1. Fertile plant. 2. Mouth of perianth. 3. Sterile stem. 4. Leaves. 5. Cells.

Monoicous. Calcicolous. In thin yellowish-green to blackish patches. Stems 5–10 mm long, prostrate, flexuous, more or less branched; rhizoids numerous to apex of stem. Leaves on the sterile stems broader than the stem, rather obliquely inserted, erecto-patent, slightly channelled, ovate-quadrate, divided to the middle or slightly deeper into two triangular, *acute* lobes, 6–8 cells broad at base, the sinus open and generally obtuse; leaves on the fertile stem larger, transverse, rotund-quadrate, $\frac{1}{2}$ bilobed, the sinus acute, lobes triangular, *acute;* cells *15–20* μ, subquadrate, the walls considerably and equally thickened; cuticle smooth. Underleaves *absent.* ♀ inflorescence at the apex of the stem and branches; bracts in 2–3 pairs, larger than the leaves; involucral bracts connate in the *lower half with the bracteoles* but with their antical margins free, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, the sinus acute, the lobes *subtriangular, acute, the margins entire or slightly dentate*; bracteole large, ovate-quadrate, truncate or shortly bidentate. Perianth oblong, deeply 5-plicate, hyaline at the apex, the mouth crenulate with *elongated cells.* Capsule shortly oval. Spores 8–12 μ, reddish-brown, finely granular. Androecia intercalary on elongated

branches; bracts in 4–10 pairs, imbricate, resembling the stem leaves but larger and more concave. Antheridia globose, solitary.

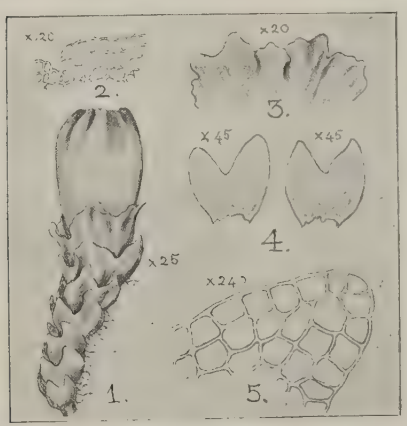
Hab. Steep, chalky banks.

Distrib. Sussex, 1906 *(W. E. Nicholson)*.

This southern calcicolous plant is allied to *C. integerrima*, from which it differs by the involucral bracts being acute and frequently dentate, more acute leaf-lobes, rather larger cells which have also more thickened walls, the mouth of the perianth with more elongated cells and the spores larger. It agrees with that species in the highly connate bracts, and differs in this regard from our other species, but the bracts do not form a complete cup as in *C. integerrima*, the antical margins being free.

168. Cephaloziella integerrima (Lindb.) Warnst.

Cephalozia integerrima Lindb., Hep. in Hib. lect. p. 502 (1875); Medd. Soc. Fl. F. Fenn. 1; Musc. Scand. p. 4 (1879); Spruce, On Ceph. p. 66 (1882).
Cephalozia Bryhnii Kaal., De Dist. Hep. Norv. p. 152 (1893).
Cephaloziella integerrima Warnst., Krypt. Fl. Mark Brand. p. 232 (1902); Nicholson, Hast. and East Suss. Nat. 1, 6 p. 280 (1911).
Cephaloziella pyriflora Douin, Musc. d'Eure et Loire p. 262 (1906).



1. Fertile plant. 2. Mouth of perianth. 3. Bracts and bracteole. 4. Leaves. 5. Cells.

Monoicous. Very small. In thin dark green patches. Stems 2–5 mm long, prostrate, flexuous, sparingly and shortly branched; rhizoids numerous. Leaves on the sterile stems broader than the stem, patent, divided to the middle or slightly deeper into two triangular, subacute lobes, the sinus open and generally obtuse; leaves on the fertile stem larger, erecto-patent, imbricate, cuneate-quadrate to subovate-quadrate, concave, ½ bilobed, the sinus angular or obtuse, the lobes subovate, patent, *very obtuse* or sometimes subacute; cells 14–18 μ, subquadrate, the walls thin; cuticle smooth. Underleaves *absent* or rarely one or two present near the apex of the sterile stems. ♀ inflorescence at the apex of the stem; bracts in two to three pairs, larger than the leaves,

involucral bracts *connate in the lower half with each other and with the bracteole to form an excipulus, irregularly 2–3-lobed, the lobes rounded, the margins entire.* Perianth longly exserted, cylindrical to oblong-pyriform, 3–4-plicate towards the apex, not hyaline, the mouth slightly crenulate *with short cells.* Capsule oval. Spores *6–8* μ, reddish-brown, finely granulate. Androecia frequently occupying the whole of a short branch, bracts imbricate, very concave, shortly bilobed, the lobes obtuse.

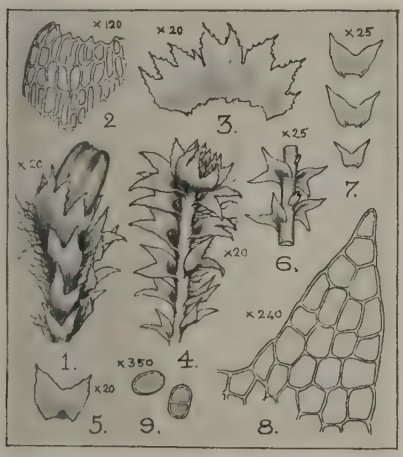
HAB. Moist sandy ground.

DISTRIB. Sussex, 1906 *(W. E. Nicholson).*

The irregularly rounded lobes of the involucral bracts at once distinguish this plant from any of our other species. They are highly connate with one another and with the bracteole. The leaf-lobes are also in general obtuse. *C. Bryhnii* only differs in the involucral bracts having occasionally more acute lobes, but bracts also occur which are identical with those of *C. integerrima*.

169. Cephaloziella stellulifera (Tayl. MS.) Schiffn.

Jungermannia stellulifera Tayl., MS.
Cephaloziella stellulifera Schiffn., Oest. Bot. Zeit. 8 p. 1 reprint (1905).



1. Fertile plant. 2. Mouth of perianth. 3. Bracts and bracteole. 4. Plant showing young paroicous inflorescence. 5. Sub-involucral bract. 6. Stem, with underleaves. 7. Leaves. 8. Cells. 9. Gemmae.

Paroicous. In pale yellowish-green depressed patches on soil. Stems 5–9 mm long, pale green above, brown below, flexuous and sometimes geniculate, ascending, sparingly branched, frequently with an innovation from below the ♀ inflorescence; rhizoids long, hyaline, rather numerous below and at the geniculations, scarce elsewhere. Leaves small and distant on the lower parts and on the sterile stems but always broader than the stem, slightly concave, quadrate, divided to below the middle into two *lanceolate*, acute and somewhat divaricate segments, but sometimes slightly incurved,

4–6 cells broad at the base, the sinus obtuse; leaves greatly increasing in size on the fertile stems, approximate but appearing distant from being *squarrose*, *oval-quadrate*, bilobed to *below the middle* into subovate-lanceolate, acute, entire, divaricate and convex segments, *6–9* cells broad at the base, the sinus open and generally round. Cells *16–21* μ, oblong-quadrate, the walls *slightly* and nearly equally thickened; cuticle smooth. Underleaves *always present*, small, subulate or bifid on the sterile stems, frequently large towards the upper part of the fertile stems and ovate-subulate or triangulur-subulate and with a tooth at one side. Subinvolucral bracts in 3–5 or more pairs, imbricate, with the *upper* $\frac{1}{3}$–$\frac{1}{2}$ *squarrose*, also sometimes distant and isolated, resembling the leaves but larger, broader, less deeply bilobed and with the segments more acutely pointed, the margin rather remotely *dentate*, the teeth obtuse or acute, mostly 1 cell long, rarely with the margin only crenulate. Antheridia 1–2, oval, shortly pedicellate. Involucral bracts *squarrose before the perianth is mature*, later with only the apex squarrose, connate at the lower third with each other and with the bracteole, unequally 2–3-lobed to $\frac{1}{3}$–$\frac{1}{2}$, the lobes ovate-lanceolate, acute, the margins *dentate* to crenulate-crenulate, sometimes with 1–2 spinulose teeth in addition; bracteole oblong-quadrate, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, the lobes acute, the margin slightly dentate and frequently with one or two larger teeth. Perianth narrowly oblong, plicate above, the mouth crenulate-dentate with elongated cells. Gemmae on the margins of the uppermost leaves and underleaves, green, roundish-oval, 1–2-celled.

HAB. Moist loamy and clayey soil.

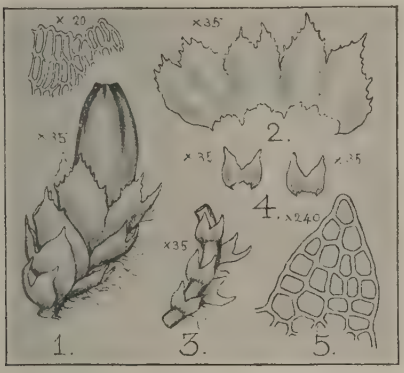
DISTRIB. N. to Argyllshire, rare.

The description (as well as the figure) is taken from the original specimen in the Edinburgh Botanical Garden Hebarium. It is labelled "*Jungermannia stellulifera* Tayl. MS., April 1842, Derbyshire W. Wilson 1833." It is, without any doubt, paroicous. Pearson's description and figures of *Ceph. stellulifera* are taken partly from Taylor's plant and partly from a monoicous plant from Cornwall gathered by Curnow, which has subsequently been named *Cephalozia divaricata* var. *Curnowii* Slater MS. This was raised by the author to specific rank, but undescribed, as *Cephaloziella Curnowii*. It is apparently a form of *C. bifida*. The description of *Ceph. stellulifera* by Heeg in *Die Leb. Niederöst.* p. 95, 1893, agrees very well with Taylor's plant, as does also, for the most part, Douin's description of *Ceph. stellulifera* in *Bull. Soc. Bot. de France* p. 250, 1905.

The margins of the upper leaves are occasionally erose through gemmae. The leaves for some distance below the bracts have sometimes one or two teeth on the margin. The bracts are squarrose before the perianth is mature and form a stellate head. They are concolorous, with the teeth most commonly obtuse and nearly always 1-celled. Male bracts with antheridia may sometimes be seen at some distance from the female inflorescence and distant from one another.

170. Cephaloziella myriantha (Lindb.) Schiffn.

Cephalozia myriantha Lindb., Medd. Soc. Fl. F. Fenn. (1875); Spruce, On Ceph. p. 70 (1882).
Cephalozia Jackii Limpr. in Spruce, On Ceph. p. 67 (1882); Heeg, Die Leb. Niederöst. p. 96 (1893).
Cephaloziella myriantha Schiffn., Oest. Bot. Zeit. 7 p. 4 reprint (1904).



1. Fertile plant, with mouth of perianth enlarged. 2. Bracts and bracteole. 3. Sterile stem. 4. Leaves. 5. Cells.

Paroicous. In thin *reddish-brown* to green patches. Stems 3–7 mm long, prostrate or ascending, on the fertile stems erect, brittle, simple or sparingly branched; rhizoids numerous to apex of stem. Leaves on the sterile stems slightly broader than or hardly as broad as the stem, erecto-patent to erecto-appressed, divided to the middle into two ovate-lanceolate acute lobes *4–5 cells broad at base*, the sinus acute; leaves on the fertile stems much larger and increasing in size upwards, patent, roundish-quadrate, concave, $\frac{1}{2}$ bilobed, the lobes ovate and acute or somewhat obtuse, the sinus acute or obtuse; cells *12–15* μ, subquadrate, the walls strongly and equally thickened or only slightly thickened; cuticle nearly smooth. Underleaves mostly absent on the sterile stem, *distinct on the fertile stems* and lanceolate to ovate, seldom bifid. Inflorescence at the apex of the stem; *subinvolucral bracts in 3–4 pairs suddenly much larger than the leaves*, concave, the lobes denticulate; antheridia broadly oval; involucral bracts large, connate with each other and with the bracteole for some distance above the base, $\frac{1}{2}$ bilobed, lobes ovate, acute, the margins *serrulate-dentate*, concolorous or nearly so. Perianth narrowly oblong, exserted $\frac{1}{2}$ beyond the bracts, 4–6-plicate, frequently reddish below, the mouth hyaline to crenulate with elongated cells. Capsule, spores and gemmae as in *C. byssacea*.

Hab. Sandy and loamy soil, seldom on stumps.

Distrib. N. to Perthshire, rare. Fr. Mar.–Aug.

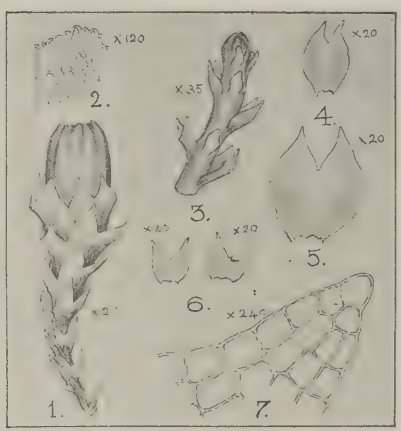
C. myriantha is smaller than the other paroicous species, *C. Limprichtii*

and *C. stellulifera*. It is frequently reddish-brown, which the others are rarely, if at all, the leaf-lobes on the sterile stems are only 4–5 cells broad at the base and the cells are smaller. Stems with male inflorescence only will sometimes be found, as well as paroicous inflorescence.

C. Jackii was formerly supposed to be distinct from *C. myriantha* in its having broader leaf-lobes, thinner cell-walls, and underleaves present on the stem, and having sometimes male branches, but Schiffner has shown from an examination of original specimens of both plants that these points of difference are not characteristic, and that they belong to the same species; Kaalaas had at an earlier date thought that this was possible.

171. Cephaloziella Limprichtii Warnst.

Cephaloziella Limprichtii Warnst., Krypt. Fl. Mark Brand. p. 228 (1902); Nicholson, Hast. and East Suss. Nat. 1, 6 p. 279 (1911).



1. Fertile plant. 2. Mouth of perianth. 3. Sterile stem, with underleaves. 4. Bracteole. 5. Bract. 6. Leaves. 7. Cells.

Paroicous. In thin yellowish-green patches, becoming brown to black with age, larger than *C. myriantha*. Stems to 1 cm long, or rather longer, prostrate, usually simple, frequently with subfloral innovations; rhizoids rather scarce. Leaves on the sterile stems distant, erecto-patent, divided to about the middle into two narrow ovate-lanceolate acute lobes *5–7 cells broad at base*, the sinus acute or obtuse; leaves on the fertile stem larger, patent, with the apex of lobes frequently incurved, oblong-quadrate, concave, $\frac{1}{2}$ bilobed, the lobes ovate-lanceolate, acute; cells *16–20* μ, rectangular or quadrate, the walls *slightly* and equally thickened; cuticle finely punctate. Underleaves *frequently distinct* both on the sterile and fertile stems, patent, subulate, seldom bifid. Inflorescence at the apex of the stem and branches; subinvolucral bracts in 3–4 pairs, larger than the leaves, imbricate, concave, $\frac{1}{3}$ bilobed, the lobes acute, *entire*; involucral bracts large, generally connate with each other and with the bracteole to above the base, broadly oval, $\frac{1}{3}$ $\frac{1}{2}$ bilobed, the sinus acute, lobes *ovate-lanceolate*, acute, *the margins entire*, seldom indistinctly and obtusely dentate. Perianth narrowly oblong,

exserted $\frac{1}{2}$ beyond the bracts, 3–6-plicate, the mouth hyaline, and crenulate with elongated, projecting cells. Capsule cylindrical-oblong. Spores 9–12 μ, reddish-brown, finely papillose. Gemmae as in *C. byssacea*.

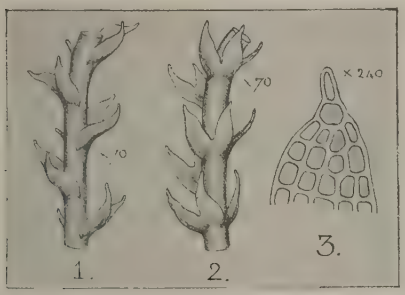
HAB. Moist sandy and loamy soil.

DISTRIB. N. to Lanarkshire, rare. Fr. April–July.

Differs from *C. myriantha* in its larger size, the leaves of the sterile stems considerably larger than the breadth of the stem, the lobes broader at base and more acute, cells larger and with less thickened walls, bracts less frequently united into an excipulus, rather more deeply lobed, the lobes narrower, more acute, and nearly always entire. *C. stellulifera* has the ♂ and ♀ bracts dentate, and squarrose when immature, leaves on the fertile stem frequently squarrose, involucral bracts dentate. The androecia may be frequently seen as small catkins at the end of short branches, before the archegonia are mature, below the perianth.

172. Cephaloziella aeraria (Pears.) Macv.

Cephalozia aeraria Pears. in Spruce, On Ceph. p. 96 (1882); Pears., Hep. Brit. Isles p. 181 *pl.* 69 (1900); Steph., Spec. Hep. III p. 322 (1908).
Cephaloziella aeraria Macv., Cens. Cat. Brit. Hep. p. 17 (1905).



1, 2. Stems, with leaves and underleaves.
3. Cells.

Dioicous. In *dense*, depressed, dark green to yellowish-brown patches. Stems to 10 mm long, *filiform*, *striate*, ascending, flexuous, simple or more frequently with a few short, widely spreading branches, *the cortical cells hyaline;* rhizoids *very long*, colourless, rather scarce. Leaves of *nearly equal size throughout*, longer than the breadth of the stem, distant, *widely spreading* to patent, cuneate-oblong, slightly concave, $\frac{3}{4}$ *bilobed or deeper*, sometimes with a tooth near the antical base, the sinus acute or obtuse, the lobes *lanceolate-subulate*, unequal, *2–4 cells broad* at the base, *acuminate or acute*, divergent, *frequently incurved*, the apex ending generally in two cells, the terminal cell *twice as long as broad;* cells 14–17 μ, rectangular to oblong, the walls pellucid, *rather strongly and equally thickened;* cuticle *papillose*. Underleaves small on the lower part of the stem, *large and subulate* above, spreading, frequently incurved, sometimes connate on one side with the leaf. ♀ *inflorescence on very short postical*

branches; bracts in three pairs, nearly twice as long as the leaves, slightly more than $\frac{1}{2}$ bilobed, the lobes ovate, acuminate, sparsely spinulose-denticulate. Gemmae at the apex of the stem and uppermost leaves.

HAB. Moist soil near copper mines.

DISTRIB. Merionethshire, very rare.

The deeply divided, subulate lobes with their frequently incurved points, the rather common presence of one or two teeth on the margin, the papillose cuticle and distinct underleaves make this species easily known from any of our *Cephaloziellae*. It has much smaller and more spreading leaves than *Prionolobus striatulus*, and thinner cell-wells.

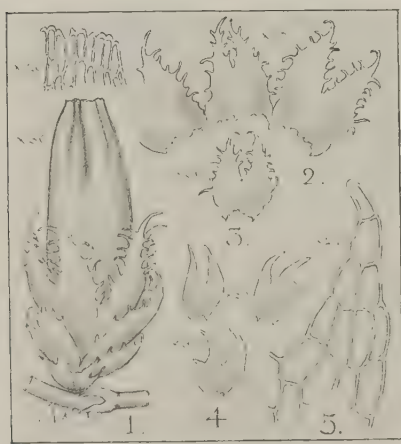
The colour is most commonly dark green above, and yellowish-brown below. One or more teeth are not unfrequently seen on the margins of the leaves. The smaller leaves are divided nearly to the base. I have not seen inflorescence, the description of this being taken from Spruce.

173. Cephaloziella elachista (Jack) Schiffn.

Jungermannia elachista Jack in G. and R., Hep. Eur. Exs. no. 574 (1873); Limpr., Krypt. Fl. Schles. p. 296 (1876).

Cephalozia elachista Lindb., Hep. in Hib. lect. p. 502 (1875); Musc. Scand. p. 4 (1879); Spruce, On Ceph. p. 70 (1882); Pears., Hep. Brit. Isles p. 184 *pl.* 71 (1900).

Cephaloziella elachista Schiffn., Oest. Bot. Zeit. 7 p. 5 reprint (1904).



1. Fertile plant, with mouth of perianth enlarged. 2. Bracts and bracteole. 3. Subinvolucral leaf. 4. Leaves. 5. Cells.

Monoicous. Very slender, pale green, creeping among *Sphagnum* or other mosses. Stems to 10 mm long, *delicate and flaccid*, ascending, sparingly branched, pale green, the antical cells *large and hyaline*; rhizoids scattered, hyaline. Leaves *distant*, much longer than the breadth of the stem, erecto-patent, subovate, divided $\frac{1}{3}$–$\frac{2}{3}$ into two long, *lanceolate-acuminate lobes*, frequently somewhat connivent and incurved at the apex, *about 4 cells broad* at the base, *very commonly with a tooth at the side*, the sinus acute or obtuse; cells *rather large*, 20–25 μ or more in length

by 12–18 μ in breadth, mostly rectangular, *the walls thin*, trigones absent; cuticle *smooth*. Underleaves absent or minute and subulate or bifid. ♀ inflorescence on a somewhat elongated or short branch; bracts in 2–3 pairs, much larger than the leaves, less deeply bilobed, the lobes dentate; involucral bracts ½ bilobed, the lobes lanceolate, *spinous-dentate to spinous-ciliate, the teeth frequently recurved*; bracteole smaller than the bracts, bilobed, the lobes spinous-dentate. Perianth elongate, longly exserted, linear-oblong, trigonous, the mouth crenulate with elongated cells. Androecia terminal or intercalary, spicate; bracts in several pairs, imbricate, concave, larger than the leaves, bilobed, the lobes strongly dentate. Gemmae at the apex of the uppermost leaves, oblong.

HAB. Moist or wet soil, bogs and wet rocks.

DISTRIB. Sussex; Ireland; very rare.

The large thin-walled leaf-cells, smooth cuticle, and the spinous-dentate and spinous-ciliate involucral bracts will serve to distinguish this delicate species. It has sometimes been confused with *Prionolobus striatulus*, but the latter has a very different appearance in its small, strongly incrassate cells of the stem and leaves, the leaves more erect, stiffer, and with a papillose cuticle.

The stems are generally leafless for part of their length. The leaves, especially on the smaller branches, are frequently divided nearly to the base.

XLIII. PRIONOLOBUS Spruce

Prionolobus Spruce, Hep. Amaz. et And. p. 508 (1885); Schiffn. in Engl. and Prantl, Die Nat. Pflanz. 1, 3 p. 98 (1895).

Minute. Stems slender, without flagella, *branches lateral, rarely postical*. Leaves transverse, complicate-bilobed to the middle or beyond, sometimes papillose, the *margin mostly dentate or spinous-dentate*. ♀ inflorescence acrogenous. Bracts large, tristichous, *strongly dentate or spinous-dentate. Perianth 4–5-angled.*

The genus, as above defined, is not sharply separated from *Cephaloziella*, but the totality of the underlined characters correspond to a group of our species which appears sufficiently distinct for generic rank. It has been most commonly treated as a subgenus.

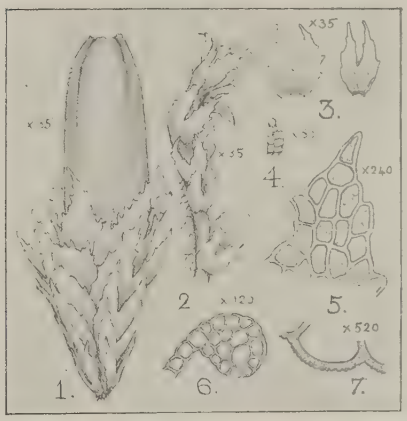
1 { Underleaves absent ..... *176. Turneri*
{ Underleaves present, distinct 2

2 { Leaves ½ bilobed, lobes broadly triangular-ovate, cuticle smooth [*dentatus*]
{ Leaves ⅔ bilobed, lobes narrowly triangular to lanceolate; cuticle papillose 3

3 { Monoicous; among *Sphagnum* ..... *174. striatulus*
{ Dioicous; on moist soil and rocks ..... *175. Massalongi*

174. Prionolobus striatulus (Jens.) Schiffn.

Cephalozia striatula C. Jens., Revue Bryol. p. 25 (1904); Steph. Spec. Hep. III p. 341 (1908).
Prionolobus striatulus Schiffn. in Douin, Musc. d'Eure-et-Loire p. 256 (1906).



1. Fertile plant. 2. Sterile stem. 3. Leaves. 4. Underleaf. 5. Cells. 6. Section of stem. 7. Antical portion of do., more magnified.

Monoicous. Minute. As scattered stems or in thin reddish-brown or pale green patches *creeping over Sphagnum.* Stems 3–7 mm long, flexuous, longitudinally *hyaline-striate*, prostrate or ascending, usually sparingly branched, the *branches postical*, more rarely lateral; rhizoids somewhat numerous to apex of stem, long and colourless. Lower leaves small, distant and entire or sinuate, upper leaves larger, approximate to subimbricate, erecto-patent, *sinuate-dentate or spinulose*, sometimes entire or nearly so, *slightly* complicate, $\frac{2}{3}$ *bilobed* or deeper, *sinus narrow*, *acute*, *lobes long*, *lanceolate*, straight or slightly incurved; cells 13–16 μ, oblong-quadrate, walls strongly and equally thickened; *cuticle* hyaline-*verrucose*. *Underleaves small*, erecto-patent or appressed, broadly subulate and irregularly lobed or bifid, sometimes dentate. ♀ inflorescence terminal on the stem. Involucral bracts large, connate at the base, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, lobes triangular-lanceolate, acuminate, irregularly spinulose-denticulate and serrate-dentate; bracteole spinous-denticulate. Perianth longly exserted, frequently rubiginous at the middle, linear-oblong, 5-plicate, the mouth slightly contracted, crenulate. Capsule oblong-oval, the inner wall with few semi-annular thickenings. Spores 7–8 μ, reddish-brown, granular-punctate. Elaters of about the same breadth as the spore, dark reddish-brown. Androecia at the end or middle of the branch, bracts rather larger than the leaves, subimbricate, subsecund.

HAB. Creeping over and among *Sphagnum*.

DISTRIB. Sussex, Lanarkshire, very rare; Ireland.

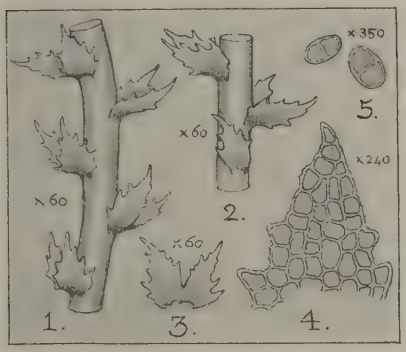
Can be at once separated from *P. Massalongi* by the monoicous inflorescence which is nearly always present; the leaves are also less concave and are more suberect in the upper part of the stem, and the underleaves are smaller. The present plant is a northern species, growing nearly always on *Sphagnum*, while the other is rather of a southern type and does not appear to have been found on *Sphagnum*. Perianths and fruit are common in *P. striatulus*; they are very rare in *P. Massalongi*.

The leaves vary greatly in the amount of armature, and a large number of them are frequently entire, but there are always some teeth on the uppermost leaves.

Apart from the teeth on the leaves and the commonly verrucose cuticle, this species is known at sight from the monoicous *Cephaloziella bifida* by the longer and narrower segments of the leaves as well as by the presence of underleaves. *C. clachista* has wider, less imbricate leaves, much larger and thin-walled cells, smooth cuticle, as well as spinons-ciliate bracts.

175. Prionolobus Massalongi (Spruce) Schiffn

Cephalozia Massalongi Spruce, On Ceph. p. 71 (1882); Massal., Spec. Ital. Gen. Ceph. in Malpighia 21 p. 41 cum *fig.* (1907).
Cephalozia dentata Pears. p.p. max., Hep. Brit. Isles p. 187 (1900).



1. Stem. 2. Postical view of do., with underleaf. 3. Leaf. 4. Cells. 5. Gemmae.

Dioicous. Minute. In pale green to reddish-brown dense patches, or as scattered stems among mosses. Stems 5–10 mm long, flexuous, prostrate or ascending, usually sparingly branched, branches lateral with frequently innovations from below the ♀ inflorescence; rhizoids rather plentiful but scarce near the apex of stem, long and colourless. Leaves approximate to subimbricate, on the sterile stem frequently somewhat distant, *subcomplicate-concave*, erecto-patent, longer than broad, $\frac{2}{3}$ *bilobed*, sinus acute, open, *lobes narrowly triangular to lanceolate*, acute or acuminate, frequently incurved at the apex, crenulate or shortly dentate, at the base spinous-dentate or spinous; cells *small, 10–14 μ*, quadrate-hexagonal, walls strongly and almost equally thickened; *cuticle more or less papillose. Underleaves distinct*, erecto-patent with the apex frequently incurved, subovate, oblong or lanceolate, frequently dentate or sometimes spinous-dentate. ♀ inflorescence terminal on the stem. Involucral bracts larger than the leaves, 2–3-lobed, lobes

acuminate and spinous-dentate ; bracteole spinous-dentate. Perianth oblong, plicate above, the mouth contracted, denticulate-crenulate. Capsule oval. Androecium median or terminal, bracts resembling the leaves but more concave. Antheridia solitary. Gemmae in clusters at the apex of the stem, reddish-brown, *oblong or elliptical*, 2-celled, with a few rotundate and stellate.

HAB. On moist or wet rocks near the sea-shore.

DISTRIB. Wales to Cornwall ; Kincardine, very rare.

This rare species differs from *P. dentatus* in the more deeply lobed leaves, with narrower lobes and smaller cells, the papillose or verrucose cuticle and the oblong gemmae ; the leaves are also less spinulose and more concave. They vary greatly in the amount of armature on the margins, being frequently only crenulate or even sinuate, but there is very often a tooth at the base ; some leaves are practically entire. Occasionally they are slightly spinous on the dorsal surface near the base. The underleaves are often subulate or linear on the smaller stems and branches.

This species can hardly be confused with *P. Turneri*, there being so many points of difference.

Douin considers that the British plant is not identical with the Italian *Cephalozia Massalongi* of Spruce, and he has given our plant the name of *Cephaloziella Nicholsoni*.

[Prionolobus dentatus (Raddi) Schiffn.]

Jungermannia dentata Raddi, Soc. Ital. Mod. p. 32 (1820).
Cephalozia dentata Lindb,. Journ. Linn. Soc. (1873) ; Spruce, On Ceph. p. 71 (1882).
Prionolobus dentatus Schiffn. in Engl. and Prantl 1, 3 p. 98 (1895).

[Dioicous. Minute. In small pale green scattered stems or thin patches on soil. Stems 2·6 mm long, prostrate, simple or sparingly branched, the branches lateral, occasionally innovant from below the ♀ inflorescence ; rhizoids rather plentiful, long and colourless, to apex of stem. Leaves distant, *widely spreading*, frequently slightly reflexed, sub-complicate, rotundate-ovate when flattened out, about as broad as long, $\frac{1}{2}$ *bilobed*, *lobes broadly triangular-ovate*, acute, *frequently divergent*, unequally spinous-dentate or serrate-dentate ; cells *14–21* μ, quadrate-hexagonal, walls considerably and nearly equally thickened ; *cuticle smooth*. *Underleaves distinct*, erecto-patent with the apex frequently incurved, irregular in shape, *ovate*, *oblong* or triangular-subulate, more or less *spinous or serrate-dentate*, the apex sometimes bifid. ♀ inflorescence terminal on the stem. Involucral bracts larger than the leaves, connate at the base, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, or 3-lobed, lobes acuminate, spinous-dentate ; bracteole ovate, spinous-

dentate. Perianth (immature) oblong, the mouth denticulate-crenulate. Gemmae in clusters at the apex of the stem, pale green to reddish-brown, *rotundate and stellate*, 1–2-celled.

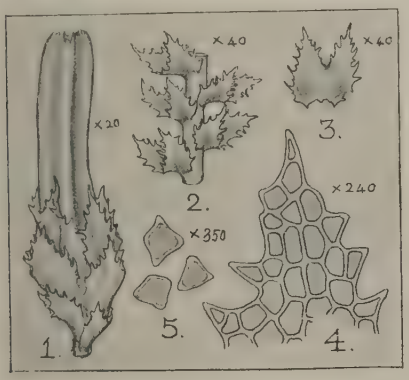
HAB. On paths in woods.

The leaf-cells are rather larger than in *P. Turneri* and the walls rather less thickened; the leaves are only slightly concave and the lobes are usually convex in the middle with the apex incurved; those on the fertile stem are closer together and more concave. The leaves often form a comal tuft at the apex of the stem.

It is more than doubtful if this species has been found in Britain. So far as specimens on which the records were founded, have been examined they belong to *P. Massalongi* or *P. Turneri*.]

176. Prionolobus Turneri (Hook.) Schiffn.

Jungermannia Turneri Hook., Brit. Jung. *pl.* 29 (1812).
Anthelia Turneri Dum., Rec. d'obs. p. 18 (1835).
Cephalozia Turneri Lindb., Journ. Linn. Soc. (1873); Spruce, On Ceph. p. 71 (1882).
Prionolobus Turneri Schiffn. in Engl. and Prantl 1, 3 p. 98 (1895).



1. Fertile plant. 2. Sterile stem. 3. Leaf. 4. Cells. 5. Gemmae.

Monoicous and dioicous. In small pale green or reddish-brown patches. Stems 3–7 mm long, flexuous, prostrate, ascending at the apex, sparingly branched, the branches lateral, rarely postical; rhizoids rather scarce and colourless, to apex of stem. Leaves approximate to imbricate, on the sterile stems more distant, *pectinate-distichous*, obtusely conduplicate-concave, $\frac{1}{2}$–$\frac{3}{4}$ bilobed, *the whole margin acutely and unequally dentate-serrate*, the antical lobe ovate-lanceolate, acute or apiculate, erect and somewhat incurved, *nearly parallel to the stem*, the postical lobe broader, acute, *patent*, slightly incurved; cells 12–16 μ, quadrate-hexagonal, walls *strongly* and nearly equally thickened; cuticle smooth. *Underleaves absent.* ♀ inflorescence terminal on an usually elongated branch. Involucral bracts nearly twice as large as the leaves, connate with each other and on one or both sides with the bracteole, $\frac{1}{3}$ bilobed, occasionally 3-lobed, lobes subacuminate; bracteole ovate-oval, acute, spinous-dentate. Perianth *longly exserted*, *linear-pentagonal*, the mouth contracted,

denticulate. Capsule oblong-oval. Androecium on the middle of the branches or sometimes terminal, bracts in several pairs, imbricate, resembling the leaves but more concave. Antheridia solitary. Gemmae at the apex of the stem, obtusely *3–4-angled*, 1-celled.

Hab. On sandy or loamy banks in shady places.

Distrib. N. to Wales, very rare ; Ireland.

The regular pectinate-distichous leaves and the absence of underleaves will distinguish this plant from our other species of the genus. The leaves are also more complicate and the antical lobe is nearly parallel to the stem while the postical lobe is patent ; the smooth cuticle and the angular gemmae will also separate it from *P. Massalongi*. The perianths are frequently arcuate ; they are common in *P. Turneri*, but are rare in *P. dentatus* and *P. Massalongi*. Rhizoids are numerous shortly below the ♀ inflorescence.

XLIV. EREMONOTUS Kaal. in Pears.

Eremonotus Kaalaas in Pears. Hep. Brit. Isles p. 200 (1900).

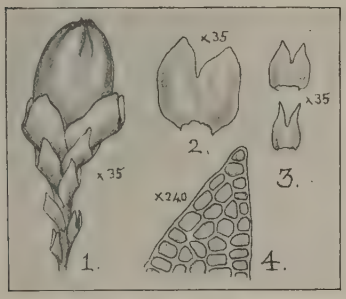
Plant small, densely caespitose. Stems rigid from a leafless rhizomatous base, branches lateral ; subfloral innovations and postical flagella also present. Leaves nearly transverse, *complicate-bilobed*, the sinus and lobes acute ; *cells minute, subquadrate with thickened walls. Underleaves absent.* ♀ inflorescence terminal on the stem and innovant branches ; bracts *distichous*. Perianth frontally compressed, not distinctly trigonous, *rounded at the apex.*

177. Eremonotus myriocarpus (Carr.) Pears.

Diplophyllum myriocarpum Carr. in Carr. and Pears. Hep. Brit. Exs. no. 96 (1879).
Jungermannia myriocarpa Carr., Trans. Bot. Soc. Ed. p. 466 *pl.* 18 f. 4 (1879).
Hygrobiella myriocarpa Spruce, On Ceph. p. 75 (1882) ; Steph., Spec. Hep. III p. 360 (1908).
Eremonotus myriocarpus Pears., Hep. Brit. Isles p. 201 (1900).

Dioicous. Minute. In compact *reddish-brown* patches on moist soil-covered rocks. Stems 6–12 mm long, *rigid*, flexuous or *arcuate*, brown, ascending from an entangled rhizomatous base with a few postical flagella, simple or with few branches or *repeatedly innovant* above, the branches *lateral* ; rhizoids colourless or pale rose, scarce below and on the flagella, almost or entirely absent above. Leaves transversely inserted, minute, distant and *appressed* at the lower part

of the stem and branches, becoming approximate above on the sterile stems, accrescent and erecto-patent on the fertile stems, conduplicate-concave, *ovate-quadrate*, ½ *bilobed*, sinus acute or subacute, narrow at the base, lobes ovate to lanceolate, acute; cells *small*, *12–16 μ*, *subquadrate*, walls strongly and equally thickened; cuticle nearly smooth. *Underleaves absent*. ♀ inflorescence *terminal* on the stem and on repeatedly innovant branches. Involucral bracts much larger than the leaves, acutely conduplicate-concave, oblong-quadrate, ¼ or more bilobed, lobes obtuse or subacute; bracteole absent. Perianth exserted for half its length, *oblong*, frontally compressed, sulcate and obscurely trigonous, composed of one layer of cells, *the apex rounded*, mouth contracted, denticulate. Capsule oblong, brown, outer wall with nodular thickenings, inner wall with semi-annular thickenings. Spores 14–17 *μ*, pale reddish-brown, nearly smooth. Elaters closely bispiral, about half the breadth of the spores, reddish-brown. Androecium on the apex or middle of the stem, bracts loosely imbricate, very concave, larger and broader than the leaves, ⅓ bilobed, lobes obtuse. Antheridia single, large.



1. Fertile plant. 2. Bract. 3. Leaves. 4. Cells.

HAB. On wet rocks, usually at the sides of streams, subalpine and alpine, ascending to 3900 ft. alt.

DISTRIB. Wales to Orkney, rare. Fr. June.

A smaller plant than *Hygrobiella laxifolia* and at once distinguished from it by the absence of underleaves and the much smaller cells. It is sometimes confused with *Splenolobus Pearsoni*, *Marsupella Stableri* and *Cephaloziella byssacea*. The first named species is without a rhizomatous base or flagella, stem mostly simple and leafy throughout, leaves not accrescent, the base patent and the lobes nearly parallel to the stem with the apex incurved, and the lobes more deeply divided; the male bracts are more commonly present and more conspicuous.

Mars. Stableri closely resembles the present plant and is liable to be confused with it when only sterile plants are available. The *Marsupella* however grows directly on the rock and generally forms very thin layers; the other, always I believe, grows on a coating of soil on the rock, and it frequently forms compact tufts; it is also found on soil in rock crevices with *Hygrob. laxifolia* at the side of streams. The *Marsupella* has more appressed and more imbricate leaves, sinus not so deep and more acute, the lobes narrower, cells rounded-hexagonal, and it is generally of a rosy-purple colour which is absent in

the present plant. The bracts and perianth of the two species are of course very different.

Ceph. byssacea has distinct underleaves, is without flagella, and the leaves are not appressed and are of a different shape; the colour is also different; in fact, there is little resemblance between *E. myriocarpus* and any species of *Cephaloziella*.

The perianth frequently appears as if cladogenous on account of innovations; very often several perianths can be seen on one stem on these innovations. The rounded apex of the perianth and the small, contracted mouth is unlike other species; when immature, the perianth is oblong.

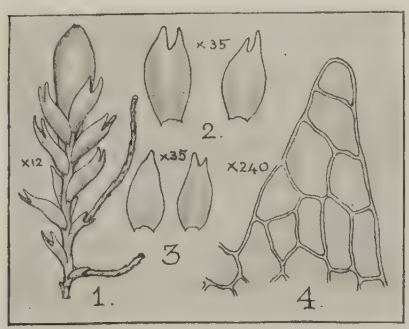
XLV. HYGROBIELLA Spruce

Hygrobiella Spruce, On Ceph. p. 73 (1882).

Plant small, laxly leaved, procumbent or erect from a *rhizomatous base, almost entirely without rhizoids*, branches few, *lateral*; subfloral innovations and postical flagella also present. Leaves small, transversely inserted, complicate-bilobed; cells large and *elongate* with thin walls. *Underleaves resembling the leaves* or slightly smaller. ♀ inflorescence terminal on the stem or a branch. Bracts tristichous. Perianth large, fusiform, obtusely trigonous with a *narrow mouth*.

178. Hygrobiella laxifolia (Hook.) Spruce

Jungermannia laxifolia Hook., Brit. Jung. *pl.* 59 (1813).
Gymnocolea laxifolia Dum., Rec. d'obs. p. 17 (1835).
Cephalozia laxifolia Lindb., Musc. Scand. p. 3 (1879).
Hygrobiella laxifolia Spruce, On Ceph. p. 74 (1882).



1. Fertile plant. 2. Leaves. 3. Underleaves. 4. Cells.

Dioicous. Small. In small dense *olive-brown to olive-green*, more rarely reddish-brown, patches on *wet rocks*. Stems 8–20 mm long, the cortical cells larger than the internal cells, filiform, suberect, *with microphyllous or leafless flagella* from near the base and with ascending lateral branches; *rhizoids almost absent*, a few being present near the base of the stem and on the flagella. Leaves *flaccid*, *transversely* inserted, *oval to*

oval-lanceolate, patent to erecto-patent, minute on the lower part of stem and branches, *accrescent above*, *distant* except near the apex of the fertile stem where they are sub-imbricate, *conduplicate-concave*, $\frac{1}{4}$–$\frac{1}{3}$ bilobed, on the sterile branches frequently to $\frac{1}{2}$ bilobed, *sinus narrow* and acute, *lobes narrow*, acute, or sometimes obtuse, *usually unequal*; cells very variable in size, being *long and narrow*, *42–63* μ in the larger leaves, and smaller, 28–36 μ and hexagonal-quadrate in the smaller leaves, *pellucid*, walls slightly and equally thickened; cuticle smooth. *Underleaves resembling the leaves* but rather smaller and more irregular in shape, occasionally with a few undivided. ♀ inflorescence *terminal* on the stem or branches, frequently with innovations. Bracts in 1–3 pairs, surrounding the perianth, resembling the leaves but longer, $\frac{1}{5}$–$\frac{1}{4}$ bilobed; bracteole resembling the bracts but sometimes entire. *Perianth large*, *oblong-fusiform*, obtusely trigonous, composed of two layers of cells to above the middle, the mouth contracted and *almost closed*, subdenticulate with long hyaline cells. Capsule narrowly oblong, reddish-brown. Androecia terminal or median on the stem or on long branches, or terminal on short branches which are denudate at base; bracts in 5–7 pairs, laxly imbricate, larger than the leaves, ventricose, with occasionally an antical tooth. Antheridia large, single, very shortly pedicellate.

HAB. On wet rocks, usually by the side of streams, subalpine and alpine, ascending to 3400 ft. alt.

DISTRIB. Sussex, Wales to Shetland, rather frequent in the Highlands of Scotland; Ireland. Fr. June.

Easily recognised by the underleaves resembling the leaves, and by the elongate cells of the shortly bilobed pellucid leaves; the latter appear *in situ* to be more obtuse than they really are on account of the lobes being rather difficult to see and often slightly incurved. Sterile perianths are common and are large in proportion to the plant; this appearance, together with their shape, is also sufficient to allow the plant to be recognised. The flagella are readily seen.

XLVI. PLEUROCLADA Spruce

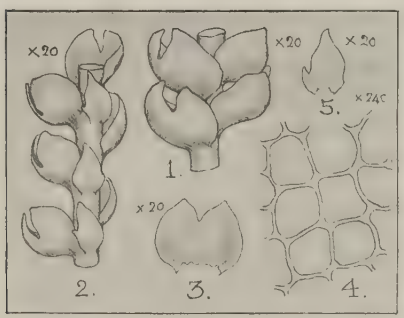
Cephalozia Dum., Rec. d'obs. p. 18 (1835).
Pleuroclada Spruce, On Ceph. p. 77 (1882).

Plants whitish or glaucescent. Stems procumbent, subpinnate, with rhizoids; branches all lateral, *subtended by a monolobed leaf.*

Leaves *transversely* inserted, *bilobed*, *very concave*. Underleaves *large*, *entire or unidentate*. ♀ inflorescence acrogenous. *Perianth fleshy*, of several layers of cells at the base, trigonous, contracted at the mouth. Capsule oblong-cylindrical, the wall of two layers of cells, inner layer with semi-annular thickenings.

179. Pleuroclada albescens (Hook.) Spruce

Jungermannia albescens Hook., Brit. Jung. *pl.* 72 (1815) et Suppl. *pl.* 4 (1816).
Cephalozia albescens Dum., Rec. d'obs. p. 18 (1835); Kaal., De Dist. Hep. Norv. p. 176 (1893).
Cephalozia islandica β albescens Lindb., Musc. Scand. p. 3 (1879).
Pleuroclada albescens Spruce, On Ceph. p. 78 (1882).



1. Stem, antical view. 2. Do., postical. 3. Leaf. 4. Cells. 5. Underleaf.

Dioicous. In *glaucous-green or whitish* depressed, compact tufts, or among mosses. Stems 1·5–3 cm long, thick and fleshy, flexuous, eflagelliferous, procumbent, laxly subpinnately branched, *branches lateral*, suberect or ascending, subtended by an ovate, monolobed leaf at the antical base; rhizoids colourless, numerous below, scarce above and on the branches. Leaves approximate to imbricate, *nearly transversely inserted*, semi-amplexicaul, not decurrent, erecto-patent, *greatly concave*, *subrotund*, $\frac{1}{3}$ or slightly further bilobed, sinus acute or obtuse, lobes triangular-ovate, *incurved*, acute or apiculate; cells 24–30 μ, quadrate-hexagonal, *pellucid*, walls somewhat thickened, the angles slightly more so. *Underleaves nearly as long as the leaves*, approximate, *subovate*, with a large suberect tooth near the base on one or both sides, or entire. ♀ *inflorescence terminal on the stem or branches*. Involucral bracts almost three times as large as the leaves, free or connate at the base, inrolled, $\frac{1}{3}$ bilobed, occasionally 3-lobed, lobes broadly triangular, acute; bracteole narrowly oblong, subdentate. Perianth longly exserted, fleshy at the base, subclavate-cylindrical, trigonous above, the mouth contracted, denticulate. Capsule oblong-oval. Spores 10–12 μ, reddish-brown, papillose. Elaters bispiral.

var. **islandica** (Nees) Spruce, On Ceph. p. 79 (1882).

Jungermannia islandica Nees, Eur. Leb. II p. 29 (1836).
Cephalozia islandica Lindb., Musc. Scand. p. 3 (1879).
Pleuroclada islandica Pears., Hep. Brit. Isles p. 194 *pl.* 76 (1900).

More slender, leaves less concave, almost exactly orbicular, sometimes bilobed to the middle, bracts less concave and rather narrower, underleaves entire and frequently narrower, perianth composed of fewer layers of cells. Androecium occupying from the middle to the apex of a branch, bracts in about 14 pairs, imbricate, erect, concave, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, with occasionally an antical tooth at base; antheridia solitary, oblong-obovate, brown, rather longly pedicellate.

Hab. On moist soil on the higher mountains.

Distrib. Perth and Forfar to Ross, 3000-4300 ft. alt., rare. Var. *islandica*, Arran to Aberdeen, descending to 2000 ft. alt.

The nearly white colour of this alpine plant, with its large underleaves, makes it unmistakable. It is frequently found on the moist soil below snow patches, commonly in more or less compact tufts among *Dicranum*.

The tooth on the underleaf is a narrow suberect lobe in most cases, usually confined to one side, but is frequently absent even in the type.

The few specimens of the var. *islandica* which have been found in Britain are not difficult to separate from the type, but the Scandinavian botanists, who have ample opportunity of studying the two plants, often have difficulty in separating them, and they do not consider them as separate species. The variety is found at lower elevations than the type both here and in Norway.

According to Spruce, the perianth of *P. albescens* is 5–8 cells thick at base and 2–4 cells thick at the middle. In the only specimen of var. *islandica* which I have seen with perianths, they were 3 cells thick at the base, and 1 cell thick from the middle to the apex. The involucral bracts of this plant were $\frac{1}{3}$ bilobed.

XLVII. ODONTOSCHISMA Dum.

Odontoschisma Dum., Rec. d'obs. p. 19 (1835).
Sphagnoecetis G. L. N., Syn. Hep. p. 148 (1844).
Cephalozia subgen. *Odontoschisma* Spruce, On Ceph. p. 59 (1882).

Plants rather large, in green, reddish or dark brown tufts. Stem creeping, not arising from a rhizomatous base; rhizoids present; *branches nearly always postical*; *flagella present*, always postical. Leaves succubous, obliquely or almost longitudinally inserted, somewhat concave, *round or ovate*, *entire* seldom emarginate; *cell-walls thickened*. Underleaves on the stem usually small, or obsolete.

♀ *inflorescence cladogenous*; bracts tristichous, generally bifid. Perianth large, trigonous, contracted at the dentate or ciliate, rarely nearly entire mouth. Calyptra thin. Capsule oval.

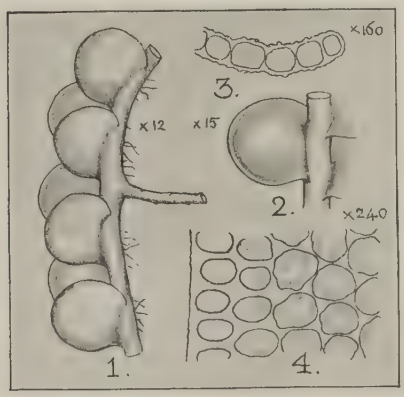
A very instructive account of this genus is given by Evans in the *Botanical Gazette* p.p. 321–346, 1903, which the student is recommended to study. In this article he shows the close relationship between this genus and *Anomoclada* on the one hand, and, as previously pointed out by Spruce, to *Cephalozia Francisci* on the other. Spruce reduced *Odontoschisma* to the position of a subgenus of *Cephalozia*, and in this he was followed by several Scandinavian, as well as by the English botanists, but latterly the full rank of genus is nearly always given to it.

1 { Underleaves absent on mature stems; gemmiferous branches wanting; leaf-cells not stellate, one marginal row distinct ..... *180. Sphagni*
Underleaves conspicuous; gemmiferous branches usually present; leaf-cells stellate, no distinct marginal row 2

2 { Brown, rarely green; papillae absent on margin of mature underleaves (in the type); on decaying wood or on peat on the low ground (v. *elongatum* in marshy alpine places) ..... *181. denudatum*
Light green; papillae present on margin of underleaves; trigones very large; on high alpine banks ..... *182. Macounii*

180. Odontoschisma Sphagni (Dicks.) Dum.

Jungermannia Sphagni Dicks., Plant. Crypt. Fasc. 1 p. 6 (1785).
Odontoschisma Sphagni Dum., Rec. d'obs. p. 19 (1835).
Sphagnoecetis communis α vegetior Nees in G. L. N. Syn. Hep. p. 149 (1844).
Cephalozia Sphagni Spruce, On Ceph. p. 60 (1882); Pears., Hep. Brit. Isles p. 171 (1900).



1. Stem. 2. Leaf. 3. Section of do. 4. Cells.

Dioicous. In scattered stems or small patches usually *creeping over or among Sphagnum*, reddish-brown or green in colour. Stems 2–5 cm long, flexuous and arcuate, simple, or sparingly branched, branches postical, *without gemmiferous branches*, flagella postical, several; rhizoids colourless, numerous to apex of stem and on the flagella. Leaves imbricate, *antically secund*, patent, broadly oval to rotundate-ovate, very obliquely inserted, the antical margin hardly or very shortly

decurrent, slightly concave, the margins somewhat incurved in the upper parts; cells 20–25 μ, *rounded*-polygonal, trigones large but smaller than in the other species, *the cell-cavity remaining rounded*, the marginal cells in one to two rows, oblong-rectangular and *forming a distinct border;* cuticle slightly verruculose. *Underleaves absent in the adult stems*, but usually present and small and inconspicuous at the apex of the young branches. ♀ inflorescence on short postical branches. Involucral bracts triangular-ovate to narrowly oblong, acute, with frequently a tooth or acute lobe on one or both sides, very shortly to $\frac{1}{3}$ bilobed, sinus and lobes acute; bracteole $\frac{1}{3}$–$\frac{1}{2}$ bilobed, sinus and lobes narrow, acute. Perianth very longly exserted, linear-fusiform, subcylindrical and slightly compressed below, plicate and slightly contracted above, three cells thick at the base and two cells thick to the middle, the mouth denticulate-crenulate and with cilia, the cilia 1–3 cells long. Capsule oval, brown, longly pedicellate, inner wall with a few semi-annular thickenings. Spores 11–14 μ, pale brown, thickly verruculose. Androecium on a short postical branch, bracts transverse, imbricate, ventricose, complicate, shortly bilobed, lobes acute or apiculate; bracteole ovate-oval, acute, the margin sinuate-dentate. Antheridia single. *Gemmae absent.*

var. **erectum** Macv. nov. var.

In tall erect tufts, partly or wholly submerged, pale brown to greenish-brown. Stems elongate, *6–8 cm* long, *erect*, simple; rhizoids rather scarce, absent above. Leaves *distant*, *explanate*, *frequently emarginate or shortly bilobed*, the sinus often acute, trigones smaller.

Hab. Among *Sphagnum* on moist moors.

Distrib. N. to Shetland, rarely ascending above 1200 ft. alt., frequent; Ireland. Fr. April-June, rare. Var. *erectum* Terregles Wood, Kirkcudbright, June, 1840 *(Herb. Croall)*.

Does not resemble any species of other genera except *Jamesoniella Schraderi*, which, like it, also grows among Sphagnum, but the *Odontoschisma* may be readily distinguished by the flagella, which are always present and usually in plenty; the present plant has also a different habit, the stems lying more loosely on the *Sphagnum* and more arched. The flagella will also distinguish it from any other round-leaved species which is found among *Sphagnum*, except *O. denudatum*.

The stems are occasionally small-leaved at the apex, but never gemmiferous. Gemmae have not been observed on any part of the plant. When the leaves are laxly placed on the stem they are frequently explanate. The border of the leaf is rendered more noticeable on account of the margin being incurved.

In this species the trigones are comparatively small and do not project into the cell-cavity, which thus remains rounded. In *O. denudatum* the trigones

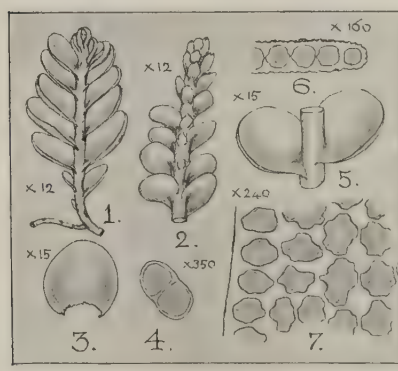
are larger and project for some distance into the cell-cavity, which thus becomes stellate, but the rays are broad and generally short. In *O. Macounii* the trigones are very large, sometimes confluent, and project so far that the cell-cavity becomes stellate with narrow rays.

Slime-papillae occur on the underleaves of all the species, but are short-lived except in *O. Macounii* and the var. *elongatum* of *O. denudatum*. They should be examined at the growing apex of the stem.

The var. *erectum* has a very different appearance from the type in its tall and erect tufts and distant leaves, which are here and there bilobed. In Stabler's *Hep. and Musc. of Westmoreland* in *The Naturalist* p. 234 (1898) there is a var. *Stableri* Spruce from Foulshaw Moss "Foliis crassis insigniter opacis, saepe retusis emarginatisve: foliolis semper praesentibus, haud raro profunde bifidis, segmentis subulatis setaceisve." This evidently belongs to *O. denudatum* with its opaque leaves and with underleaves always present. This is rendered the more probable by Stabler's reference to his doubts as to his specimen of *O. denudatum* from Foulshaw Moss being "the true plant," with the remark that "possibly it may be a small starved gemmiparous state of *Ceph. Sphagni*." I may add that I have seen a specimen of the common moor form of *O. denudatum* from the locality.

181. Odontoschisma denudatum (Nees) Dum.

Jungermannia denudata Nees in Mart., Fl. Crypt. Erlang. p. xiv (1817).
Odontoschisma denudatum Dum., Rec. d'obs. p. 19 (1835).
Sphagnoecetis communis β macrior Nees in G. L. N., Syn. Hep. p. 149 (1844).
Sphagnoecetis Huebeneriana Rabh., Deutsch. Krypt. Fl. 2 p. 338 (1848).
Cephalozia denudata Spruce, On Ceph. p. 61 (1882); Pears., Hep. Brit. Isles p. 174 (1900).



1. Stem, antical view. 2. Do., postical. 3. Leaf. 4. Gemma. 5. Leaves on stem. 6. Section of leaf. 7. Cells.

Dioicous. In green to reddish-brown patches *on decaying wood, peat, or sandstone rocks*. Stems 1–2 cm long, arcuate, prostrate and *almost leafless below*, *erect above*, simple or branched, *usually small-leaved and gemmiferous at the apex*, branches postical, rarely with some also lateral; flagella postical, few and mostly from near the base of stem; rhizoids colourless, numerous at the base of stem and on the flagella, almost absent above. Leaves largest at the middle of the stem, becoming smaller and gemmiferous towards the apex, rotundate to broadly oval or with the apex occasionally retuse, imbricate, *not secund*,

erecto-patent to patent, slightly obliquely inserted, concave, the *antical* margin somewhat incurved and shortly or hardly decurrent; cells 21–28 μ, *opaque*, trigones very large rendering *the cell-cavity stellate* with broad rays, the marginal cells only slightly differing from the others and not forming a distinct border; *cuticle papillose*. *Underleaves numerous*, frequently destroyed or smaller below but becoming *as large as the leaves towards the apex of the stem*, *erecto-patent*, quadrate or oblong, sometimes bifid at the apex. ♀ inflorescence on short postical branches. Involucral bracts broadly ovate, $\frac{1}{3}$ bilobed, lobes acute, the margins undulate and dentate. Perianth longly exserted, narrowly fusiform, contracted and plicate above, the mouth denticulate. Capsule oval. Spores 11–14 μ, brown, thickly verruculose. Androecium on a short postical branch, bracts transverse, imbricate, ventricose, complicate, shortly and acutely bilobed. *Gemmiferous branches erect; gemmae abundant on the apex of the stem or uppermost leaves* and on the underleaves, oblong or oval, frequently somewhat contracted in the middle, yellowish-green, 2-celled, more rarely 1-celled, thin-walled.

var. **elongatum** Lindb. in Not. Sallsh. pro F. Fl. Fenn. 13 p. 361 (1874).

Odontoschisma elongatum Evans, Rhodora p. 13 (1912).

In large, flat, brown to yellowish-brown patches in marshy ground. Stems elongate, prostrate and ascending, *almost equally leaved*, branches few, postical and lateral. Gemmiferous branches scarce or absent. *Underleaves on the stem large*, usually numerous, quadrate to oblong-quadrate, *with slime-papillae on the surfaces and margins*. Cell-structure as in the type, occasionally with some leaves having less thickened and brown walls.

Hab. Moist, bare, peaty soil, stumps, and decaying logs. Var. *elongatum*, alpine marshes and wet moors.

Distrib. N. to Shetland, rarely ascending above 1000 ft. alt., uncommon; Ireland. Fr. May–August, rare. Var. *elongatum*, Dumbarton, Perth, seldom below 2000 ft. alt.

The common form of this species differs from *O. Sphagni* in being smaller, in the habitat, the more compact tufts, stems denudate and entangled at base, flagella fewer, leaves less obliquely inserted and more concave, not secund, considerably larger at the middle of the stem than at the base and apex, becoming small and deformed by gemmae towards the latter, the constant presence of underleaves, the cell structure and the more papillose cuticle. Any form of this species can be distinguished from *O. Sphagni* by the cell structure; this shows in some of the leaves, at least, large trigones with stellate cell-cavities, nearly always opaque, and the marginal row of cells not sufficiently distinct from the

others to form a border. In *O. Sphagni* the margin of the leaf is incurved in the upper half; in *O. denudatum* the antical margin is incurved throughout its whole length, the postical margin being also sometimes slightly incurved.

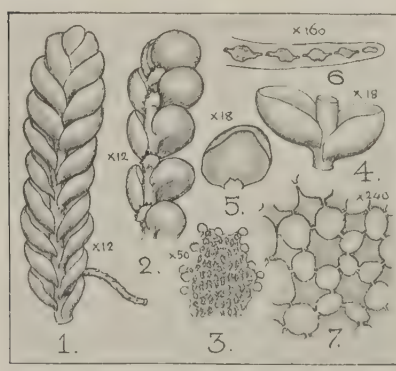
The typical plant is confined to the low ground in Britain.

The var. *elongatum* is generally an alpine plant and is liable to be confused with *O. Sphagni*, but the large underleaves on some of the stems, as well as the cell structure, will distinguish it, although in many of the leaves the trigones are small. It is a distinct plant, and has recently been elevated to specific rank by Evans. A slender, prostrate, pale green form occurs in Orkney, with the stems somewhat elongate, leaves mostly explanate, and with large, confluent trigones.

Jamesoniella subapicalis is sometimes found in similar habitats to this species, but may be distinguished by the absence of flagella and of gemmae, leaves mostly longer than broad, trigones smaller and the terminal inflorescence.

182. Odontoschisma Macounii (Aust.) Underw.

Sphagnoecetis Macounii Aust., Bull. Torr. Club 3 p. 13 (1872).
Sphagnoecetis communis var. *tessellata* Berggr., Musc. et Hep. Spetsberg. p. 101 (1875).
Jungermannia tessellata Berggr., loc. cit. p. 43 (1875).
Odontoschisma Macounii Underw., Bull. Ill. State Lab. Nat. Hist. 2 p. 92 (1884).
Cephalozia Austini Pears., List. Canad. Hep. p. 10 (1890).
Odontoschisma tessellatum C. Jens., Meddel. om Grönland 15 p. 365 f. 1 4 (1898).



1. Stem, antical view. 2. Do., postical. 3. Underleaf. 4. Leaves on stem. 5. Leaf. 6. Section of do. 7. Cells.

Dioicous. In *pale green to whitish-green* depressed patches *on alpine rocks*. Stems 8–15 mm long, stout, flexuous, almost leafless below, *prostrate* or with the apex ascending, simple or sparingly branched, sometimes small-leaved and gemmiferous at the apex, *branches most commonly lateral*, less frequently postical, occasionally flagelliferous towards the end, flagella postical, mostly from near base of stem, with distant rudimentary leaves; rhizoids colourless, scarce, except on the flagella and base of stem. Leaves imbricate, erecto-patent to *suberect*, *broadly rotundate*, obliquely inserted, *semi-amplexicaul*, *greatly concave*, the antical margin widely incurved, not decurrent; cells 23 28 μ, *trigones very large*, occasionally as large as the cell cavities and rendering them

markedly stellate with linear rays, the marginal cells only slightly differing from the others and not forming a border; cuticle *greatly thickened, smooth*. Underleaves small or large, becoming equal in size to the leaves towards the apex of the gemmiferous stems and *concave and appressed*, oblong-ovate or rounded, with numerous slime-papillae. ♀ inflorescence on a short lateral or postical branch. Involucral bracts complicate, ovate, $\frac{1}{4}$ bilobed, sinus and lobes acute, the margins subentire or with a few irregular teeth; bracteole resembling the bracts. Perianth oblong, contracted at the base and apex, obtusely trigonous, plicate above, the mouth entire or crenulate. Capsule oval. Spores 14 μ, brownish, minutely verruculose. Androecium on a short lateral or postical branch; bracts in 3–4 pairs, complicate, ventricose, shortly bilobed or truncate. *Gemmiferous branches prostrate;* gemmae as in *O. denudatum* but with thick walls.

Hab. On soil-covered alpine rocks.

Distrib. Ben Heasgarnich, Perth, 3000 ft. alt. *(P. Ewing & W. Young).*

Is not likely to be confused with the other species of the genus, the pale green colour, the greatly concave, almost cucullate-concave leaves and the very large trigones will distinguish it, also the habitat, which is quite different from that of the others. The leaves are thick and the large trigones give them a pellucid appearance under the microscope. The leaves are occasionally large at the middle of the stem and decrease towards the base and apex.

This species has the habit and appearance of *Alicularia scalaris* and might be very easily overlooked for it in the field; but there is no resemblance on examination.

XLVIII. ADELANTHUS Mitt.

Adelanthus Mitt., Journ. Linn. Soc. p. 264 (1864).
Adelocolea Mitt., Challenger Exped. Bot. I 2 p. 106 (1884).

Stems suberect, arising from a rhizomatous base, often decurved at the apex, simple or little branched, with postical flagella at the base. Leaves succubous, almost transversely inserted, *decurvo-secund*, obliquely rotund or ovate, the antical margin entire, *incurved*, the postical usually *spinulose-dentate*; cells small, strongly thickened at the angles, the basal longer. Underleaves indistinct. ♀ *and* ♂

inflorescence on very short postical branches. ♀ bracts tristichous, the innermost rather smaller than the leaves, the apex bifid or variously incised. Perianth pyriform or fusiform, 3–5-angled, contracted at the mouth. *Calyptra fleshy*, bearing the sterile archegonia. Androecia amentiform, antheridia solitary, very rarely in pairs.

This genus resembles *Plagiochila* in habit, but it has the antical margin of the leaf inflexed, instead of being reflexed as in that genus. The position, etc., of the inflorescence is quite different.

Margin of leaf with 2–3 spinous teeth.....*183. decipiens*
Margin of leaf with 7–14 teeth ; antical margin strongly and narrowly incurved *184. dugortiensis*

183. Adelanthus decipiens (Hook.) Mitt.

Jungermannia decipiens Hook., Brit. Jung. *pl.* 50 (1830).

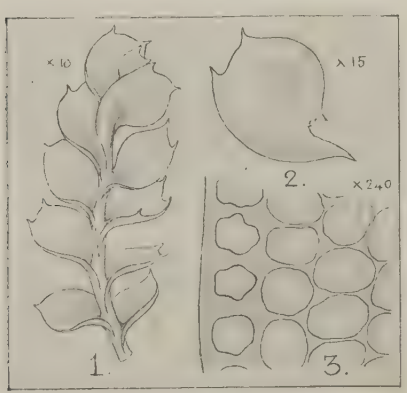
Radula decipiens Dum., Syll. Jung. p. 43 (1831).

Plagiochila decipiens Dum., Rec. d'obs. p. 15 (1835) ; G. L. N., Syn. Hep. p. 24 (1844).

Adelanthus decipiens Mitt., Journ. Linn. Soc. p. 264 (1864).

Sphagnoecetis decipiens Hartm., Skand. Fl. ed. 10 II p. 144 (1871).

Adelocolea decipiens Mitt., Challeng. Exped. Bot. 1 2 p. 106 (1884).



1. Stem. 2. Leaf. 3. Cells.

Dioicous. In wide and rather compact patches, *dark green*, becoming *nearly black when dry*. Stems 1·5–3 cm long, *dark brown*, rigid, arising from an intricate rhizomatous base, with small-leaved flagella in the lower part, simple or with subfastigiate or occasionally furcate, erect or flexuous branches *frequently decurved at the apex;* rhizoids colourless, almost confined to the lower part of stem and to the flagella. Leaves distant, small, *entire, truncate and appressed below*, upper

leaves larger, subimbricate to imbricate, patent to erecto-patent, somewhat postically secund, *slightly concave*, suborbicular or rhomboid with a narrow base, the antical margin longly decurrent and *inflexed*, *the apex truncate and shortly bispinous*, or variously rounded or subacute and *1–3 spinous-dentate*, some leaves occasionally shortly bilobed; cells 33–37 μ, *rounded*-hexagonal, *trigones rather large*, *reddish-brown*, the marginal cells subquadrate with larger trigones and substellate cell-cavities, often giving the appearance of a dark border to the leaf, cells at apex of leaf with the trigones frequently confluent; cuticle smooth. Underleaves absent or rudimentary. ♀ inflorescence on a very short postical branch from near the base of the stem. Involucral bracts rather shorter than the leaves, subrotund, the apex bilobed, lobes subentire. Perianth longly exserted, obovate-pyriform, obtusely trigonous above, the mouth trifid, ciliolate. Calyptra fleshy, slightly shorter than the perianth. Androecia *on very short*, *denudate*, *postical* branches, mostly from the lower part of the stem, bracts in 3–5 pairs, *hyaline with very thin walls*, approximate or imbricate, ventricose, very concave, the apex shortly emarginate, sinus small and acute. Antheridia usually solitary, globose, pedicel short.

HAB. On moist shady rocks, less frequently on trees.

DISTRIB. Wales to West Inverness, rare; Ireland.

Is only likely to be confused with *Plagiochila spinulosa* and especially with the var. *inermis* Carr., but may be distinguished in the field from any form of that species by its dark green colour, nearly black in dry weather, and by the tufts being more compact. *Plag. spinulosa* takes various shades of reddish-brown when dry, but never the nearly black colour of the *Adelanthus*. Under the lens, the slightly concave leaves caused by the inflexed antical margin, together with the 1–3 spinous apex of the leaf, will remove any doubt. The postical male inflorescence, which is common, is also very different from that of *Plagiochila*.

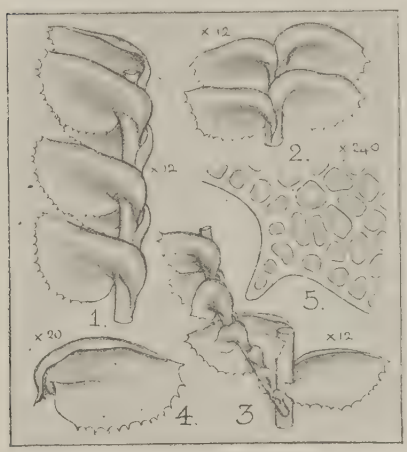
The leaves at the middle of the stem are widely spreading and appear as if distant, and are longly decurrent; near the apex of the stem they are suberect, less decurrent and more concave, the antical margin being there considerably inflexed.

The female inflorescence has not been noted in Europe.

The most usual habitat of this plant is on half-buried stones and rocks, but it is frequent also on trees. It only occurs in moist shaded places, generally in ravines, not far from the west coast. It is never found on trees except in the most shaded and humid places; in such localities it forms patches of several inches to a foot or more in diameter. It is usually unmixed, but not rarely is also present with *Plag. spinulosa* and other species of moist, shaded, rocky banks.

184. Adelanthus dugortiensis Douin et Lett

Adelanthus dugortiensis Douin, Revue Bryol. p. 53 et fig. (1904); Lett, Journ. Bot. p. 201 (1904); Steph., Spec. Hep. III p. 380 (1908).



1. Stem, lateral view. 2. Do., antical view. 3. Do., postical view. 4. Leaf. 5. Cells.

Sterile. In *dark brown* loose tufts among mosses, resembling in habit *Anastrepta orcadensis*. Stems 6–10 cm long, in depauperate plants smaller, blackish-brown, *rigid*, arising from an intricate rhizomatous base, with several small-leaved flagella principally in the lower part, with erect lateral flexuous, sometimes fastigiate branches curved at the base and rising to the antical side of the stem, circinate at the apex; rhizoids colourless, almost confined to the lower part of the stem and the flagella. Leaves smaller below, larger and closely imbricate above, *strongly postically secund*, semi-amplexicaul, *ovate-oval*, the antical margin entire, shortly decurrent, *strongly and narrowly incurved*, the basal portion being also raised and appressed to the stem, the postical margin arcuate, broadly reflexed, *dentate* except at the base, the teeth distant, acute, mostly composed of a single cell; cells 16–21 μ, rounded-hexagonal, walls reddish-brown, considerably and *equally thickened*, trigones absent or seldom present and small, cells near margin very strongly thickened, at middle of base linear-rectangular to 56 μ long; cuticle smooth.

Hab. On shady rocks.

Distrib. Near Dugort, Slievemore, Achill Island, Ireland, 2000 ft. alt. 1903 *(H. W. Lett)*, 1911 *(J. B. Duncan & D. A. Jones)*.

Resembles a dark form of *Anastrepta orcadensis* in colour and habit. The narrowly inflexed antical margin is unlike that of any of our other species; in fact, the plant cannot be mistaken. The teeth on the postical margin are commonly acute and composed of one hyaline cell, seldom of two cells, but some of them are very frequently broken off about the middle or at the base. Near the base of the stem the leaves are often entire, ovate-oval to elliptical-oval in shape, as on the flagella. The teeth increase in number as the leaves approach

the apex of the stem, where they are usually about twelve to fourteen. On a side view the leaves only slightly project over the antical side of the stem, but greatly so over the postical side; the antical base of the leaf is nearly appressed to the stem, while the postical margin is broadly reflexed; the leaves are thus twisted on their axis, which gives them the appearance of facing backwards, and has caused the postical aspect of the plant to be mistaken, as in the original description, for the antical.

This is the most interesting addition which has been made to our hepatics for many years. It is one of the group of relics of a warmer climate. Its nearest allied plant is *Adelanthus unciformis* (Tayl.) from the southern hemisphere. The Irish plant was found in company with *Herberta adunca*, *Bazzania tricrenata*, *Plagiochila spinulosa*, and *Scapania gracilis*.

XLIX. CALYPOGEIA Raddi

Calypogeia Raddi, Mem. Soc. Ital. d. Sci. in Modena 18 p. 42 (1820).
Kantia S. F. Gray, Nat. Arr. Brit. Pl. 1 p. 706 (1821).
Cincinnulus Dum., Comm. Bot. p. 113 (1822).

Stems prostrate or ascending at the apex, simple or with a few branches proceeding from the axil of the underleaves; rhizoids usually numerous and long, from the base of the underleaves. Leaves *incubous*, alternate, flat or convex, oblong, *ovate* or subrhomboidal, *the apex rotundate, less frequently acute*, sometimes bidentate, the margins entire. *Underleaves everywhere present*, $\frac{1}{5}$–$\frac{1}{2}$ as large as the leaves, *roundish* or reniform, *the apex usually bifid*, the margin entire or unidentate. ♀ and ♂ *inflorescence on very short branches arising from the axils of the underleaves.* ♀ bracts in 2–3 pairs, much smaller than the leaves, subrotund, oval or lanceolate, entire or 2–4-fid. Perianth absent. *Perigynium with rhizoids, fleshy, pendulous, cylindrical*, crowned at the mouth with persistent scale-like bracts, and lined internally with papilliform cells. Calyptra adnate with the perigynium for three-quarters of its length. Capsule longly pedicellate, cylindrical, the valves erect and *spirally twisted*, the wall of two layers of cells, the inner layer with numerous semi-annular thickenings. Elaters bispiral. Androecium spicate, bracts in 3–5 pairs, much smaller than the leaves, ventricose, bilobed and with an antical tooth.

All the described European species except *C. Mülleriana* Schiffn. occur in Britain, but there is much difference of opinion regarding the value of several of them. All writers accept *C. arguta* and *C. Trichomanis*, but agreement ends at this point. The divergence of opinion is owing to the opposing views as

to the limit of *C. Trichomanis*, but the tendency of recent years has been to accept as species some segregates of that plant. The separation of *C. fissa* and *C. Trichomanis* is of long standing, but most of the others were first described by Arnell & Persson in the "Revue Bryologique," 1902. The difficulty lies in the variability of *C. Trichomanis* under different conditions, some authors preferring to group all or nearly all the disputed forms under the single species *C. Trichomanis*. It seems however, more in accordance with facts to treat several of them as distinct. *C. Trichomanis* and *C. fissa* in their typical habitats, viz., on loamy soil, are very distinct, and although they may resemble each other considerably when in wet ground, especially when among Sphagnum, they can still usually be readily distinguished, and they simulate one another rather than grade into one species. *C. Neesiana* might be considered as originating as a drier ground form of *C. Trichomanis*, but it has now become sufficiently distinct to allow it to be recognised, even when on very wet Sphagnum. *C. sphagnicola* may be seen as a well developed small plant, and in this condition is unlike an immature small state of *C. Trichomanis*. One need not expect to be able to name the species from a stem or two which have been casually gathered. It is necessary to find the plant in mature condition. Elongated stems in all the species have distant and longly decurrent leaves, and with the cells frequently much larger than normal. The size of the leaf-cells varies greatly even in typical plants, as does also the presence or absence of trigones, but the characters of each species can be generally recognised when the plant is fairly well developed.

1. Underleaves large, rotundate, entire or seldom more than $\frac{1}{4}$ bilobed, lobes broad and round 2
   Underleaves smaller, $\frac{1}{2}$ or more bilobed, lobes obtuse or acute, seldom rounded 3

2. Underleaves entire or retuse, seldom $\frac{1}{3}$–$\frac{1}{4}$ bilobed, 2–3 times as broad as the stem, trigones of leaf-cells generally distinct..... *186. Neesiana*
   Underleaves $\frac{1}{4}$ bilobed, scarcely twice as broad as the stem, trigones generally absent ..... *185. Trichomanis*

3. Underleaves deeply bifid, with subulate segments; leaves with two acute, usually divergent teeth at apex; cuticle striate-verruculose..... *191. arguta*
   Underleaves without subulate segments; leaves entire, or with two small, not divergent teeth; cuticle smooth..... 4

4. Underleaves semilunar; plant submerged, pale yellowish-green, leaves usually distant, narrowly oblong-oval to triangular-ovate ... *189. submersa*
   Underleaves not semilunar; plant not submerged 5

5. Plant large, stems 2–4 cm long, underleaves twice as broad as long *187. fissa*
   Plant small, stems ·5–2·5 cm long, underleaves less than twice as broad as long..... 6

6. Dioicous; on decaying wood; minute; gemmiferous stems numerous and conspicuous ..... *190. suecica*
   Monoicous; among sphagnum; gemmiferous stems not conspicuous *188. sphagnicola*

185. Calypogeia Trichomanis (L.) Corda

Mnium Trichomanis L. *p.p.*, Sp. Plant. p. 1114 (1753).

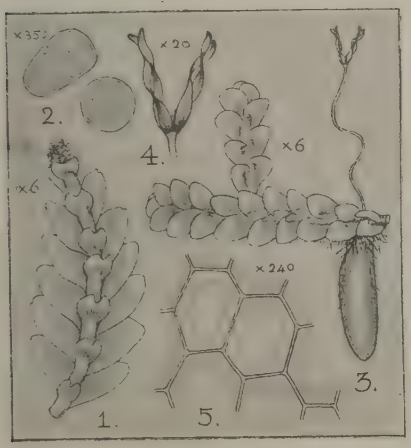
Calypogeia fissa β integrifolia Raddi, Mem. Soc. Ital. d. Sci. in Modena 18 p. 44 (1820).

Calypogeia Trichomanis Corda in Opiz, Beitr. p. 653 (1829).

Calypogeia Trichomanis α communis Nees, Eur. Leb. III p. 8 (1838).

Kantia Trichomanis Lindb., Hep. in Hib. lect. 508 (1875).

Cincinnulus Trichomanis α communis Boulay, Musc. de la France 2 p. 51 (1904).



1. Stem (postical view). 2. Gemmae. 3. Fertile plant. 4. Valves of capsule. 5. Cells.

Paroicous and sometimes monoicous. In thin, flat, green to bluish-green or brownish-green patches. Stems 2–4 cm long, thick, prostrate, or ascending at the apex, sparingly branched; rhizoids long and colourless, numerous from the base of the underleaves. Leaves very obliquely inserted, patent at an angle of about 60 degrees, imbricate, slightly convex, ovate, *the apex rotundate or broadly obtuse*, seldom shortly bidentate, slightly or not decurrent; cells *40–50* μ, hexagonal, pellucid, the walls thin or slightly thickened, *trigones generally absent;* cuticle smooth or nearly so. Underleaves *orbicular*, scarcely twice as broad as the stem, slightly decurrent, approximate to somewhat distant, ¼ *bilobed*, the sinus narrow, rounded-obtuse to obtuse at the base, *lobes rounded obtuse*, the *margins entire*. ♀ inflorescence on very short branches, proceeding from the axils of the underleaves. Perigynium solitary or geminate, subcylindrical. Capsule longly pedicellate, cylindrical, brown, the wall of two layers of cells, the inner layer with numerous reddish-brown semi-annular thickenings. Spores 10–13 μ, smooth, pale brown Elaters 8–10 μ broad, reddish-brown, bispiral. Androecia on very short branches from the axils of the underleaves, at first capitate, at length linear-spicate; bracts in 2–3 pairs, subrotund, concave, 2–3-lobed; antheridia 1–2, oval. Gemmae in subglobose clusters

on the attenuate and small-leaved apices of the stem or branches, rotund to ellipitical, 1–2-celled, yellowish-green.

var. **aquatica** Ingham, Rev. Bryol. p. 7 (1906).

In *large*, *flaccid*, *bluish-green* tufts in wet ground, sometimes partly submerged. Stems thin and flaccid, brown; rhizoids long, numerous. Leaves patent, imbricate, broadly ovate, apex rounded-obtuse, distinctly decurrent; branch leaves more distant, oblong from a broad base, occasionally subfalcate, *greatly decurrent* and giving the stems more or less of a *winged appearance;* cells somewhat smaller than in the type, 35–45 μ, sometimes larger, the walls very thin. Underleaves rather smaller, orbicular to orbicular-ovate, $\frac{1}{3}$ *bilobed*, the sinus rounded-obtuse to lunate, lobes rounded-obtuse, the margins entire.

Hab. Banks, side of ditches, logs, and peat moors, ascending to 3000 ft. alt.

Distrib. N. to Shetland, common; Ireland. Fr. April–June. Var. *aquatica* Upper Wharfedale, Yorkshire 1904 *(W. Ingham)*.

Typical plants of this species and of *C. fissa* are found prostrate on loamy soil on banks, etc., and are then easily separated; the descriptions are taken from such plants. The leaves of *C. Trichomanis* are rotundate-obtuse and the apex entire, rarely are they bidentate in well developed leaves; the underleaves are large and orbicular with a small sinus extending to about $\frac{1}{4}$ the depth of the underleaf, the lobes are rounded-obtuse and the margins are nearly always entire. In *C. fissa*, the well developed leaves are very frequently bidentate at the apex, which is narrowed, the underleaves are proportionally smaller, broader than long, $\frac{1}{2}$–$\frac{2}{3}$ bilobed, the sinus wider, the lobes less rounded at the apex and more divaricate, and the margins frequently have a broad tooth or lobule on one or both sides; not unfrequently this tooth is large and the underleaf becomes 3-lobed; there are also frequently to be seen some deeply incised leaves with acute lobes. When these species occur in wet ground, especially when among *Sphagnum*, they may lose their prostrate habit, and the characters vary a good deal, but nearly always there are mature stems to be found with the characters of the typical plant. Elongated stems have distant and longly decurrent leaves and usually smaller and more deeply divided underleaves. The leaf-cells vary greatly in size in both species, but are generally larger in *C. fissa*.

On the submerged stems of the var *aquatica* the leaves are all longly decurrent, the underleaves frequently more deeply divided, and the stem sometimes with several branches in the upper part. The whole plant is very flaccid. The leaves are seldom emarginate.

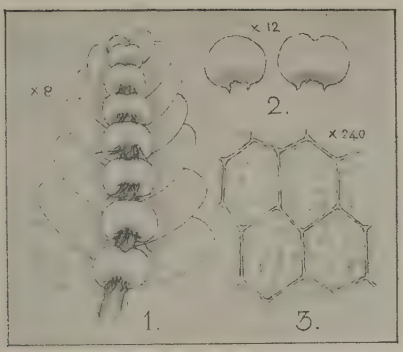
186. Calypogeia Neesiana (Carest. et Massal.) Massal.

Calypogeia Trichomanis α 3 *β* Nees, Eur. Leb. III p. 9 (1838).

Kantia Trichomanis var. *Neesiana*, Carest. et Massal., Ep. Alp. Penn. in Nuova Giorn. Bot. It. 12 p. 351 (1880).

Calypogeia Neesiana Massal., Le Spec. d gen. *Calypogeia* in Malpighia 22 p. 13 reprint (1908).

Calypogeia integristipula Steph., Spec. Hep. III p. 394 (1908).



1. Stem (postical view). 2. Underleaves. 3. Cells.

Paroicous. In thin, flat, pale green and somewhat glaucous to yellowish-green patches. Stems 2–3·5 cm long, thick, prostrate, sparingly branched; rhizoids long, colourless, numerous. Leaves closely imbricate, patent to patent-divergent, slightly convex, *oval to ovate-oval*, slightly decurrent, the apex *narrowed but rotundate-obtuse* or sometimes truncate, rarely shortly bidentate; cells *smaller* than in *C. Trichomanis*, 35–45 μ, polygonal, the walls thin, *trigones generally distinct*; cuticle smooth. Underleaves *orbicular to orbicular-reniform*, 2–3 times as broad as the stem, appressed, slightly decurrent, approximate to subimbricate near the apex of the stem, *the apex rounded and entire or slightly emarginate*, seldom $\frac{1}{5}$–$\frac{1}{4}$ bilobed with rotundate lobes. Capsule cylindrical, brown. Androecia below the ♀ inflorescence; bracts in 4–5 pairs, 2–3-lobed. Gemmae as in *C. Trichomanis*.

Hab. Sand rocks, banks and peat moors.

Distrib. N. to Inverness, rare.

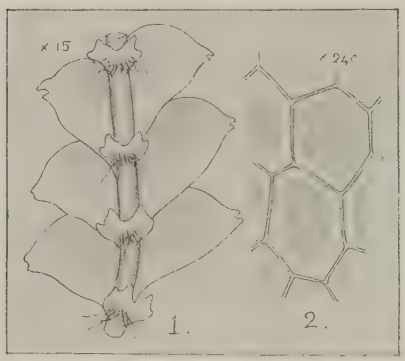
Distinguished from *C. Trichomanis* by the underleaves, which are entire or retuse at the apex or slightly emarginate, rarely $\frac{1}{5}$–$\frac{1}{4}$ bilobed; they are also appressed and frequently comparatively broader than in the other; the leaf-cells are also somewhat smaller and the trigones generally distinct. When the plant occurs among *Sphagnum* the underleaves are more distant and more frequently slightly bilobed, but they remain in general characteristic of this species. *C. Neesiana* is variously given specific or varietal rank by authors. It appears to be a fairly distinct species.

187. Calypogeia fissa (L.) Raddi

Mnium fissum L. *p.p.*, Sp. Plant. p. 1114 (1753).
Jungermannia fissa Scop., Fl. Carn. 2 p. 348 (1772).
Jungermannia calypogeia Raddi, Atti dell Acc. d. Sci. in Siena 9 p. 236 *pl.* 3 *f.* 4–6 (1808).
Calypogeia fissa Raddi, Mem. Soc. Ital. d. Sci. in Modena 18 p. 44 *pl.* 6 *f.* 3 (1820).
Calypogeia Trichomanis a 2 *repanda* Nees, Eur. Leb. III p. 9 (1838).
Kantia calypogeia Lindb., Hep. Utv. p. 20 (1877).

Kantia Sprengelii Pears. (non *Jung. Sprengelii* Mart.), Hep. Brit. Isles *pl.* 52 (1900).

Calypogeia Trichomanis β *fissa* Massal., Le Spec. Ital. d. gen. *Calypogeia* in Malpighia 22 p. 9 reprint (1908).



1. Stem (postical view). 2. Cells.

Monoicous. In thin, flat, bluish-green patches, rather more slender and pellucid than *C. Trichomanis*. Stems 2–4 cm long, thinner, fragile, prostrate or ascending, sparingly branched; rhizoids long and colourless, numerous from the base of the underleaves. Leaves very obliquely inserted, patent-divergent to horizontal, slightly convex, with the apex frequently decurved, broadly ovate, slightly or not decurrent, *the apex narrowed and bidentate*, the sinus narrow, obtuse or subacute, *the teeth small and variable*, being triangular-ovate and 3–5 cells broad at base to nearly obsolete, the apex subacute to obtuse, with *a few leaves sometimes narrowly incised to* $\frac{1}{3}$, *with ovate-lanceolate, acute lobes*; cells rather *larger* and more pellucid than in *C. Trichomanis*, 45–55 μ, the walls thinner, trigones absent or minute; cuticle smooth. Underleaves smaller, usually much *broader than long*, more than twice as broad as the stem, slightly or not decurrent, distant, patent, $\frac{1}{2}$–$\frac{2}{3}$ *bilobed*, the sinus acute or obtuse at base, the lobes *divaricate*, obtuse to subacute, *the margins very frequently with a broad lobe or obtuse tooth above the middle*. Capsule cylindrical, brown. Spores 9–11 μ, smooth, pale brown. Elaters 8–10 μ, broad, reddish-brown, bispiral. Gemmae as in *C. Trichomanis*. Androecia spicate, bracts in 3–4 pairs, bilobed, with an antical tooth.

Hab. Banks, sides of ditches, bogs and peat mosses, ascending to 2300 ft. alt. in the Highlands, but seldom above 1000 ft. alt.

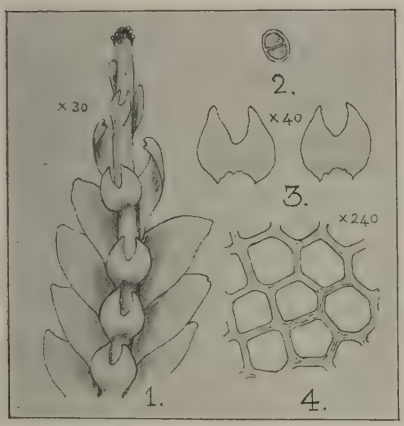
Distrib. N. to Shetland, common; Ireland. Fr. April–June.

This plant is variously given by authors as a species or as a variety of *C. Trichomanis*. It seems sufficiently distinct to be regarded as a species. Notes on the distinguishing characters are given under *C. Trichomanis*. Lindberg considered that the monoicous inflorescence of this plant was one of the best characters to distinguish it from the other, which he held to be paroicous, but Douin has shown that the inflorescence of *C. Trichomanis* is variable, and that it can also be monoicous as in *C. fissa*.

It seems doubtful at present which plant the *Jung. Sprengelii* of Martius is; it is most frequently considered to be a slender form of *C. Trichomanis*, or of *C. fissa* when growing among Sphagnum, with deeply bifid underleaves having acute lobes.

188. Calypogeia sphagnicola (Arnell et Perss.) Warnst. et Loeske

Kantia sphagnicola Arn. et Perss., Rev. Bryol. p. 26 *f.* 1–8 (1902).
Calypogeia sphagnicola Warnst. et Loeske, Verh. Bot. Ver. Prov. Brand. p. 320 (1905).
Calypogeia Trichomanis var. *sphagnicola* Meylan, Rev. Bryol. p. 53 (1909).



1. Stem (postical view). 2. Gemma (× 260 only). 3. Underleaves. 4. Cells.

Monoicous. *Small.* In small green to pale yellowish-green patches or scattered stems among Sphagnum. Stems 1–2·5 cm long, rigid, thin, ascending, simple or slightly branched; rhizoids long and colourless, numerous to apex of the stem. Leaves *erecto-patent* to patent at an angle of about *45 degrees*, imbricate, *distinctly convex* with the apex deflexed, obliquely ovate, the *apex narrowed* and rounded-obtuse to obtuse, sometimes subacute, emarginate, decurrent; cells *small*, *30–35* μ, the walls much *thickened*, trigones more or less distinct. Underleaves orbicular to orbicular-ovate, scarcely twice as broad as the stem, approximate to somewhat distant, patent, $\frac{1}{2}$ *or slightly more deeply bilobed*, the sinus lunate or obtuse, the lobes narrowly oblong-ovate, subacute, erect with the apices sometimes incurved or slightly divaricate, the margins entire, rarely with a tooth on one side. ♂ bracts in 4–5 pairs, $\frac{1}{2}$ bilobed, with an antical tooth, the lobes acute with the apex incurved. Gemmae at the apex of attenuated, small-leaved, erect branches, in subglobose clusters, rotund to oval, 2-celled.

Hab. Among Sphagnum on moors and in bogs.

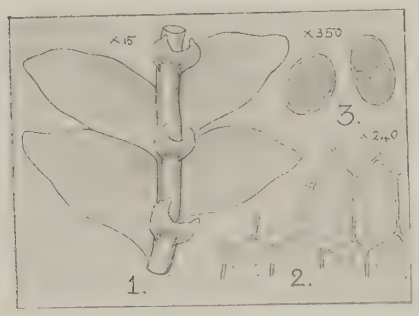
Distrib. Sussex *(W. E. Nicholson)*. East Inverness 1904 *(Miss Macvicar)*.

The small size and rigidity of the plant, the leaves spreading widely from the stem, the cells with usually distinct trigones, and the deeply bifid underleaves, characterise this species. The monoicous inflorescence will assist in distinguishing it from *C. Trichomanis*. Immature stems of that species and of *C. fissa* may resemble the present plant, but well developed specimens are quite distinct. This species has only been found in two counties at present, but it will doubtless be found in others.

189. Calypogeia submersa (Arnell) Massal.

Kantia submersa Arnell, Rev. Bryol. p. 30 (1902); Wheldon, Journ. Bot. p. 17 (1903).

Calypogeia submersa Massal., Le Spec. d. gen. *Calypogeia* in Malpighia 22 p. 11 reprint (1908); Steph., Spec. Hep. III p. 394 (1908).



1. Stem (postical view). 2. Cells. 3. Gemmae.

Sterile. In large, intricate patches, *submerged in pools*, *pale yellowish-green above* and dark lurid green below. Stems 3–4 cm long, *slender*, green, becoming brown when old, erect or ascending, simple or sparingly branched; rhizoids short and scarce. Leaves of nearly equal size throughout, patent, imbricate, obliquely ovate to oblong-ovate, slightly convex, decurrent; on the branches *approximate to distant*, almost longitudinally inserted, flat and *markedly distichous*, *narrowly oblong-ovate*, rather longly decurrent; apex of leaf narrowed and obtuse, seldom emarginate; cells very variable, 40–60 μ, the walls very thin, trigones absent. Underleaves scarcely twice as broad as the stem, patent, rather distant, $\frac{1}{2}$ *bilobed*, *the sinus very broad and semilunar*, the lobes unequal, triangular-ovate, obtuse to subacute, straight or slightly connivent or slightly divergent. Gemmae at the apex of erect and slender small-leaved branches, in pale yellowish-green clusters, globose to oval, 2-celled.

Hab. Submerged in pools in Sphagnum bogs.

Distrib. Cockerham Moor, Lancashire, 1900 *(J. A. Wheldon)*.

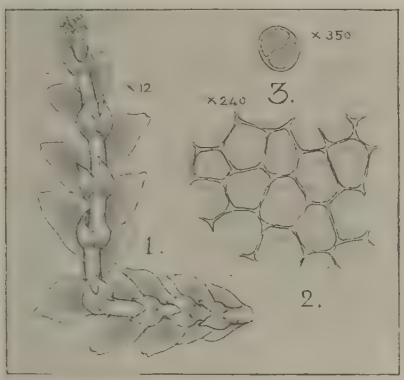
I cannot consider this to be only an aquatic form of *C. Trichomanis* as done by Meylan in "Revue Bryologique" 1908 p. 73. The slenderness of the

plant, the pale, yellowish-green colour, the narrowed, distichous leaves, and the broad, semilunar sinus of the underleaves, which are themselves in a manner semilunar, are quite distinct. The characters are not founded on a few slender, isolated stems which would naturally give rise to doubt. The plant grows in large masses, with leaves in all stages of maturity, and it certainly has not the appearance of an abnormal form of any other of our species.

C. submersa is a very pretty plant when spread out on paper as done with aquatic plants in general, the leaves remaining flat and extended on both sides of the stem.

190. Calypogeia suecica (Arnell et Perss.) K. Müll.

Kantia suecica Arn. et Perss., Rev. Bryol. p. 29 *f.* 1–6 (1902).
Calypogeia suecica K. Müll., Beitr. z. Bot. Centralbl. p. 224 (1904); Steph., Spec. Hep. III p. 404 (1908).



1. Stem (postical view). 2. Cells. 3. Gemma.

Dioicous. Minute, in thin whitish-green patches on decaying wood, resembling in size and habit *Cephalozia media*. Stems 5–8 mm long, pale green, arcuate, with several branches in the lower part, simple above and *ending in erect and small-leaved gemmiferous apices;* rhizoids long and numerous below, nearly absent towards the apex of the stem. Leaves subimbricate to rather distant, patent at an angle of about 50 degrees, rising from the stem but convex, *triangular-ovate* on the larger stems, *oblong-rectangular* to subovate on the smaller stems and on the branches, the apex rounded-obtuse to subacute, not infrequently retuse or minutely bidentate, rather longly decurrent; cells *small, 25–33 μ*, the walls thin, *trigones distinct.* Underleaves rotundate, about twice as broad as the stem, erecto-patent, subimbricate to distant, *about ½ bilobed*, the sinus triangular or semilunar, the lobes broadly triangular, *acute*, the margins on both or one side *frequently with an acute or obtuse tooth* above the middle. *Gemmiferous stems numerous and conspicuous;* gemmae on the distant and small-leaved apices of the stem, globose or oblong, hyaline, 2-celled.

Hab. Decaying logs in shady ravines.

Distrib. Resipol, West Inverness, 1899 *(S. M. Macvicar).*

The Scottish plant is minute, being identical with the original plant from Sweden, and it has been confirmed by the author of the species. A much larger plant is also included in the species by some of the more southern Continental botanists. Our Northern plant is distinguished by its small size, pale whitish-green leaves which are frequently suberect with the apex variously formed, the small cells and distinct trigones, the underleaves rather deeply bilobed and frequently with a tooth at the sides, the numerous gemmiferous branches and the dioicous inflorescence. It seems always to occur on decaying wood. Meylan, who includes large forms with this species, gives some distinctions from *C. Trichomanis* in the capsule and its walls and contents, these being on a smaller scale than in the latter species (*Rev. Bryol.* p. 10, 1908).

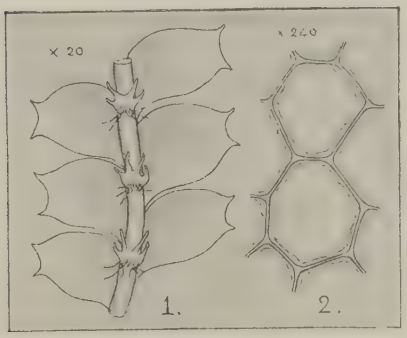
The underleaves are divided rather less than to the middle, but on some of the branches they may be divided for two-thirds.

191. Calypogeia arguta Nees et Mont.

Calypogeia arguta Nees et Mont. in Nees, Eur. Leb. III p. 24 (1838); G. L. N., Syn. Hep. p. 199 (1844).

Cincinnulus argutus Dum., Hep. Eur. p. 117 (1874).

Kantia arguta Lindb. in Not. soc. F. Fl. Fenn. 13 p. 363 (1874); Hep. in Hib. lect. p. 507 (1875).



1. Stem (postical view). 2. Cells.

Dioicous. Small. In very thin, flat, whitish-green patches. Stems 1–2·5 cm long, translucent, slender, prostrate, simple or more or less branched, the branches frequently microphyllous; rhizoids long and rather numerous. Leaves *distant*, seldom approximate, very obliquely inserted, patent-divergent, *oblong-oval* to oblong-ovate, rather strongly decurrent, the apex narrowed and *bidentate*, the sinus broad and usually semilunar, *the teeth very acute and most frequently divergent*. 2 cells broad at base and with 3 single cells; cells large, 40–56 μ, the walls slightly thickened, trigones minute, marginal row of cells generally elongate and rectangular, *cuticle distinctly and minutely striate-verruculose*. Underleaves small, patent, slightly broader than the stem, bifid to below the middle, the sinus obtuse or lunate, the *segments divergent, linear-subulate*, almost spinous, the margin *on both sides with a long subulate tooth*. Androecium oblong, the bracts in 2–4 pairs, very concave, 2–3-lobed, the lobes acuminate; antheridia solitary. Gemmiferous branches entirely microphyllous or only

towards their extremities, frequently almost denudate; gemmae in clusters at the apex, pale yellowish-green, globose to oval, 1–2-celled.

HAB. Loamy and sandy banks and sides of ditches.

DISTRIB. N. to Shetland, uncommon, most frequent near the west coast; Ireland.

This distinct species cannot be confused with any other. The leaves are always bidentate, the teeth very acute, and most commonly divaricate. The only possible mistake would be to confuse small scattered stems of *C. fissa* for it, but the distinctly striate-verruculose cuticle of the leaf in *C. arguta* will at once distinguish it from *C. fissa* or any other of our species of the genus.

C. arguta is a delicate plant with flat almost whitish leaves, which are commonly rather distant from one another and lie flat on the soil. It forms very thin patches; in fact, the stems are usually separate from one another. It is frequently found in company with *C. fissa*.

L. BAZZANIA S. F. Gray

Bazzanius S. F. Gray, Nat. Arr. Brit. Pl. 1 p. 704 (1821).
Pleuroschisma Dum., Rec. d'obs. p. 19 (1835).
Mastigobryum G. L. N., Syn. Hep. p. 214 (1844).

Dioicous. Plants mostly robust, commonly olive to flavescent or reddish. Stems ascending, furcately branched and producing several small-leaved flagella from the postical side. Leaves *incubous*, flat or convex, oblique, frequently decurved, the base semi-cordate, *narrowed to the obliquely truncate and usually tridentate apex. Underleaves everywhere present*, frequently broader than the stem, *roundish-quadrate, generally 4-dentate*, rarely subentire. ♀ and ♂ inflorescence on short postical branches. ♀ bracts smaller than the leaves. Perianth ovate-subulate or fusiform, fleshy at the base, where it is tricarinate in the young state, later 6-plicate or subterete, with the apex only trigonous. Capsule oblong, of several layers of cells, the innermost with semi-annular thickenings. Androecia amentiform or capitate, bracts in 4–5 pairs, imbricate, complicate-concave; antheridia generally in pairs.

This is a large genus, mostly tropical and subtropical, with the leaves having great uniformity of character, which makes the species difficult to separate. The underleaves usually give more distinct characters. The flagella are conspicuous, and conduct water and salts from the substratum to the plant, as well as holding it more firmly in position. Perianths are rarely present.

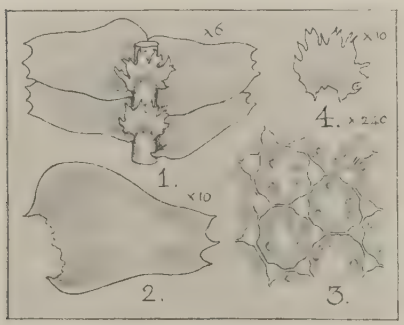
1 { Leaves horizontal, not much altered when dry, apex broadly truncate; in large green, compact tufts ..... *192. trilobata*
Leaves deflexed, greatly so when dry, apex obliquely truncate or acute; in loose brown or ochraceous tufts 2

2 { Usually ochraceous; leaves reniform with large overlapping base, cell-walls greatly thickened ..... *195. Pearsoni*
Usually reddish-brown, seldom yellowish; leaves oblong-ovate, base smaller, little or not overlapping 3

3 { Leaves 2–3-dentate; cells 24–30 μ; underleaves irregularly 3–4-lobed *193. tricrenata*
Leaves 2-dentate or entire and acute, seldom 3-dentate; cells 16–25 μ; underleaves emarginate, seldom 3–4-lobed ..... *194. triangularis*

192. Bazzania trilobata (L.) Gray

Jungermannia trilobata L., Sp. Pl. p. 1133 (1753).
Bazzania trilobata Gray, Nat. Arr. Brit. Pl. I p. 704 (1821).
Pleuroschisma trilobata Dum., Rec. d'obs. p. 19 (1835).
Herpetium trilobatum Nees, Eur. Leb. III p. 49 (1838).
Mastigobryum trilobatum G. L. N., Syn. Hep. p. 230 (1844).



1. Stem (postical view). 2. Leaf. 3. Cells. 4. Underleaf.

Dioicous. In *large yellowish-green patches*, becoming whitish-green when dry. Stems 3–10 cm long, *stout*, green, rigid, erect or procumbent, furcately branched, the branches somewhat circinate at apex, flagella several, frequently branched; rhizoids colourless, scarce, almost absent above. Leaves 3–4 mm long, imbricate, convex, *horizontal, only slightly altered when dry*, very obliquely inserted, asymmetrically oblong-ovate, the antical base strongly arched, slightly decurrent, the apex narrowed and *truncate-trilobed*, sinus lunate or acute, lobes triangular, acute or apiculate, sometimes subobtuse; cells 28–36 μ, rounded-hexagonal, swollen at the margin, trigones large; cuticle finely granulate. Underleaves large, suberect, *quadrate*-rotund, slightly broader than long, the apex *irregularly 4–5-lobed*, the *margins incisolobate* to sinuate-entire. ♀ inflorescence on a short postical branch. Involucral bracts broadly ovate, $\frac{1}{3}$–$\frac{1}{2}$ laciniate-ciliate, laciniae 4–5 in number at the apex, the margins more or less longly and

obtusely ciliate. Perianth lanceolate, trigonous above, the mouth contracted and obtusely 3-lobed. Capsule oblong-oval, composed of five layers of cells. Spores 12–15 μ, brown, thickly papillose. Elaters bispiral, reddish-brown. Androecium on a short postical branch, shortly spicate, bracts small, concave, the apex truncate or dentate. Antheridia generally single.

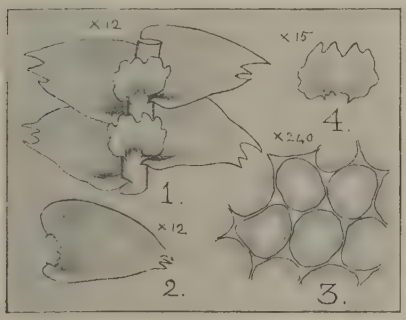
HAB. On moist, shaded rocky banks and on rocks.

DISTRIB. N. to Ross, uncommon; Ireland.

The large green cushions, nearly whitish when dry, are quite unlike our other species, nor is there any other plant with which it can be confused. The leaves are strongly convex at the base but the remainder of the leaf is nearly flat, so that the leaf is only slightly deflexed as compared with *B. tricrenata*. The underleaves are more lobed than in the other species and the margins are usually lobed or incised. The ♀ plant is common in Britain; the ♂ is much less so; fruit has not been found in this country.

193. Bazzania tricrenata (Wahl.) Pears.

Jungermannia tricrenata Wahlenb., Fl. Carp. p. 364 (1814).
Bazzania tricrenata Pears., Hep. Brit. Isles p. 132 *pl.* 49 (1900).



1. Stem (postical view). 2. Leaf. 3. Cells. 4. Underleaf.

Dioicous. In large *reddish-brown* tufts or scattered among mosses, *smaller and more slender than B. trilobata*. Stems 3–8 cm long, brown, *filiform*, flexuous, erect or procumbent, simple or furcately branched, slightly circinate at apex, flagella several, frequently branched; rhizoids colourless, scarce, almost absent above. Leaves to 1·5 mm long, imbricate, *greatly decurved* and more so when dry, appearing as if somewhat erecto-patent, but horizontal when flattened out, very obliquely inserted, slightly falcate, *triangular*-ovate or oblong, the antical base somewhat arched, *not or occasionally slightly crossing the stem*, slightly decurrent, the apex *much narrowed* and *obliquely 2–3-dentate*, sinus acute or lunate, teeth irregular, narrowly triangular, acute; cells 24–30 μ, rounded-hexagonal, smaller at the margin, trigones rather large; cuticle

finely granulate. Underleaves large, twice as broad as the stem, erecto-patent, broader than long, rotundate to rotund-quadrate, the apex *irregularly 3–4-lobed*, the margins sinuate-lobulate or entire. ♀ inflorescence on a short postical branch. Involucral bracts inrolled, ovate, 2–3-dentate at the apex. Perianth 3–4 cells thick near base, 2 cells thick at middle, lanceolate-fusiform, trigonous above, the mouth contracted and crenulate. Capsule cylindrical-oblong, shortly pedicellate, pale reddish-brown, innermost layer with semi-annular thickenings. Spores 15–17 μ, vinous-purple, thickly papillose. Elaters bispiral, contorted, long and attenuate, 6–7 mm broad, pale yellow.

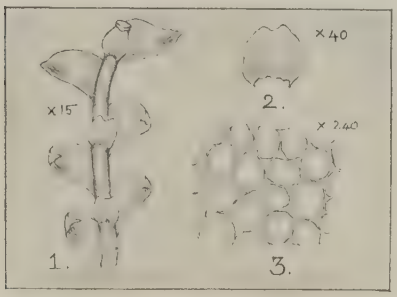
HAB. Rocky banks, rock ledges, and grassy slopes, subalpine and alpine, ascending to 3000 ft. alt.

DISTRIB. Wales to Orkney, frequent to common in the Highlands of Scotland; Ireland.

Is a much more slender plant than the preceding and cannot be mistaken for it; the leaves are more convex and are decurrent, the apex being bent back and frequently also upwards and much narrower in proportion: the apex is seldom truncate as in *B. tribolata*, but is commonly oblique; the teeth are narrower and more acute and the sinus is occasionally deeply incised. The plant is never of a pale green colour or whitish when dry, being usually reddish-brown, sometimes yellowish-brown, rarely ochraceous. It often forms rather extensive tufts, though very frequently found in mixture, especially with *Anastrepta orcadensis*.

194. Bazzania triangularis Pears.

Jungermannia trilobata γ *minima* Hook., Brit. Jung. no. 76 (1815).
Bazzania triangularis Pears., Hep. Brit. Isles p. 130 *pl.* 48 (1900).



1. Stem (postical view). 2. Underleaf. 3. Cells.

Dioicous. *Smaller and more slender than B. tricrenata, In small, dense tufts*, less frequently as scattered prostrate stems, rarely taller and loosely caespitose among mosses, olive-green to golden-yellow in colour. Stems 1·5–4 cm long, filiform, flexuous, generally with few branches and with few flagella when erect or procumbent, usually with several branches and many flagella when prostrate, the branches

divergent. Leaves *small*, to 1 mm long, *distant or approximate*, *convex* with the apex decurved, sometimes nearly flat, erecto-patent, or in the larger leaves almost horizontal, rarely or *not falcate*, *narrowly ovate to narrowly oblong-ovate*, the antical base not or hardly arched, not crossing the stem, the apex narrowed, *2-dentate or entire and acute*, seldom 3-dentate, the teeth when present variable; cells *16–25* μ, trigones small or large. Underleaves broader than the stem, but seldom twice as broad, *patent*, oblong-quadrate to rotund-quadrate, frequently narrowly quadrate on the upper part of the stem, the apex *emarginate*, *retuse or entire*, seldom 3–4-lobed on the larger stems, the margins generally entire. Androecium on a short postical branch, globose, bracts in 4–5 pairs, cucullate-concave, broadly orbicular, truncate or shortly dentate at the apex; antheridia generally solitary.

Hab. Rocky banks and on rocks, subalpine and alpine, ascending to 4000 ft. alt.

Distrib. Wales to Shetland, uncommon; Ireland.

This plant can generally be separated in Britain without difficulty from *B. tricrenata*, and the typical states of both are so different that I have followed Pearson in describing the present plant as a species. Pearson mentions that he has doubts of its status and suggests that it may even be only the male plant of *B. tricrenata*. As in his case, I have only seen male inflorescence, which is often abundant, or no inflorescence, in typical forms of *B. triangularis*, and the typical forms of the two plants never grow in the same patch. Intermediate forms are occasionally to be met with, these being either without inflorescence, or female, so far as I have seen. The italics will shew the chief points of difference between the two plants. The size of the trigones varies in both according to the amount of exposure to shade or moisture.

There are two principal forms of this plant in Britain: (1) Stems very slender, in intricate tufts, procumbent, or erect among mosses, leaves distant on the greater part on the stem and erecto-patent, the base not broadened except sometimes on the larger leaves, never falcate, the apex most commonly entire and acute, but some leaves with two or more rarely three teeth, the leaves towards the apex of the stem frequently linear-oblong, and with oblong-quadrate, patent, entire underleaves. This form occurs in golden-yellow tufts in shady ravines, usually with abundant ♂ inflorescence, and as olive-green intricate patches on alpine rocks.

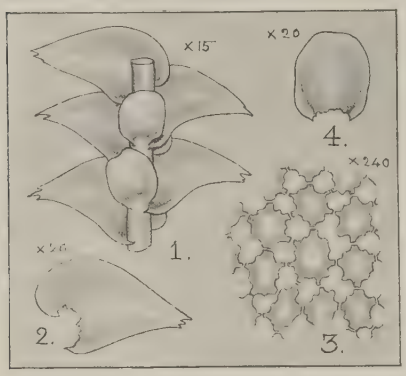
(2) Stems prostrate, with many flagella, yellowish-green to reddish, leaves approximate, broader at base, sometimes falcate, the apex frequently 2–3-dentate. This form more resembles *B. tricrenata* than does the other.

Besides the above, there is a form which occurs on wet rocks near streams, with narrow, nearly flat leaves which are frequently 3-dentate at the apex. This form I had previously considered as the var. *flaccida* Nees, but specimens of that variety in my possession include more than one form.

195. Bazzania Pearsoni (Steph.) Pears.

Mastigobryum Pearsoni Steph., Hedwigia (1893) et Spec. Hep. III p. 476 (1908).

Bazzania Pearsoni Pears., Hep. Brit. Isles p. 133 *pl.* 50 (1900).



1. Stem (postical view). 2. Leaf.
3. Cells. 4. Underleaf.

Dioicous. In small *ochraceous or yellowish-green* tufts, or scattered among mosses. Stems 3–8 cm long, yellowish-green or yellowish-brown, filiform, flexuous, simple or slightly furcately branched, slightly circinate at the apex, flagella usually few; rhizoids colourless, scarce, almost absent above. Leaves to 1·3 mm long, approximate to imbricate, greatly decurved and more so when dry, patent, very obliquely inserted, slightly falcate, triangular-ovate, *the antical base greatly arched and usually considerably crossing the stem*, not decurrent, *the apex greatly narrowed* and acute or 2–3-dentate, sinus usually acute, teeth irregular, linear to variously triangular, acute; cells *18–26* μ, rounded-hexagonal, smaller at the margin, *trigones very large*, occasionally confluent, *the cell cavity frequently stellate;* cuticle finely granulate. Underleaves *less than twice* as broad as the stem, *patent*, with the margins slightly recurved, *oblong-oval*, *the apex rounded*, *truncate or emarginate*, *the margins entire*. ♀ inflorescence on a short postical branch. Involucral bracts inrolled, ovate, 2–3-dentate at the apex, the margins crenulate-denticulate or subentire.

Hab. On shady rock ledges.

Distrib. Killarney; Achill Island; very rare.

The greatly arched antical base of lobe which crosses the stem is the most distinctive character of this species, the trigones are large, and the oblong, entire or emarginate underleaves are also characteristic of this species, though sometimes occurring also in the others. The leaf-cells are smaller than in *B. tricrenata*, and the leaves are rather more deflexed than what is usually seen in the latter All the leaf-cells are not stellate, but some will usually be found to be so in most leaves. In the original specimen they are markedly stellate with frequently narrow rays. On the branch leaves, the antical base seldom crosses the stem.

LI. LEPIDOZIA Dum.

Pleuroschisma Sect., *Lepidozia* Dum., Syll. Jung. p. 69 (1831).
Mastigophora Nees, Eur. Leb. I p. 95 (1833).
Lepidozia Dum., Rec. d'obs. p. 19 (1835); G. L. N., Syn. Hep. p. 200 (1844).
Herpetium Sect. *Lepidozia* Nees, Eur. Leb. III p. 31 (1838).

Plants rather large, rarely small, pale or yellowish-green to dark-green, caespitose, seldom erect. Stems *pinnate or bipinnate*, the branches lateral, with an antical and postical axillary leaf, sometimes flagelliferous and rooting at the end, *frequently* also *with postical flagelliferous small-leaved branches*. Leaves incubous, small, convex, oblique, usually decurved, *palmate or quadrifid*, *more rarely 2–3* or 5–6-fid, the segments acute and more or less *subulate*. *Underleaves resembling the leaves*, but generally slightly smaller. ♀ inflorescence on short postical branches. Perianth ovate-subulate or fusiform, obtusely trigonous above with the mouth entire, denticulate or ciliate-laciniate. Androecia on short postical branches, seldom terminal on lateral branches, shortly spicate.

The involucral bracts, which form a distinctive feature in our species of *Microlepidozia*, should be examined, when possible, in plants with well developed perianths; in the plant without perianths the bracts are exceedingly variable, and are very liable to cause mistakes. The position of the male inflorescence in our species of *Lepidozia* is subject to a great deal of variation. It may be found on long lateral branches and on their flagella in all the species, as well as on short postical branches, but this is exceptional and does not much detract from the value of the characters in distinguishing the various species. The elongate forms appear to have the androecia more frequently on long lateral branches than do the compact forms.

Evans in *Ann. Bot.* pp. 1–36 (1912) has described a kind of branching which is found in the subgenus *Microlepidozia*, but which is unknown elsewhere among the Hepaticae. He has shown that, in addition to the branches arising from the ventral half of a lateral segment, this subgenus has branches which arise from the dorsal half of the segment. In this case the incomplete leaf is on the ventral surface of the base of the branch, instead of being on the dorsal surface as in the other. Intercalary branching is also present.

1 { Leaves divided nearly to base, segments setaceous 2
  { Leaves not divided beyond $\frac{1}{2}$–$\frac{3}{4}$, segments not setaceous 3

2 { Innermost bracts ovate, toothed; perianth toothed ..... *199. trichoclados*
  { Innermost bracts laciniate; perianth ciliate ..... *200. setacea*

3 { Large, usually cream-coloured cushions on rocks; base of leaf-segments 8–12 cells broad; dioicous ..... *196. pinnata*
  { Thin green or yellowish-green layers, or scattered among mosses; base of leaf-segments narrower 4

4 { Monoicous; postical flagella present; androecia on short postical branches; frequently on stumps ..... *197. reptans*
  { Dioicous; postical flagella absent; androecia usually at end of long lateral branches; usually straggling among mosses, never on stumps *198. Pearsoni*

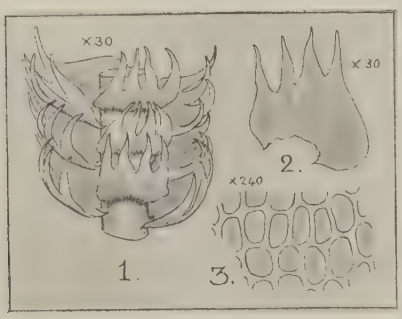
Subgen. Eulepidozia Spruce

Eu-Lepidozia Spruce (incl. *Ptilo-Lepidozia*), Journ. Bot. (1876).
Eu-Lepidozia Spruce, Hep. Amaz. et And. p. 358 (1885).
Eulepidozia Schiffn. in Engl. and Prantl, Nat. Pflanz. I 3 p. 103 (1895).

Branches lateral in most species, in a very few also postical and flagelliferous. Leaves obliquely inserted, shortly to $\frac{1}{2}$- (rarely to $\frac{2}{3}$-) quadrifid. Perianth 2–4-stratose, the mouth subentire or denticulate, rarely almost setulose.

196. Lepidozia pinnata (Hook.) Dum.

Jungermannia reptans β pinnata Hook., Brit. Jung. *pl.* 75 f. 12 (1815).
Lepidozia pinnata Dum., Rec. d'obs. p. 19 (1835).
Herpetium reptans β pinnatum Nees, Eur. Leb. III p. 32 (1838).
Lepidozia tumidula Tayl. in G. L. N. Syn. Hep. p. 206 (1844).
Lepidozia cupressina β tumidula Carr., Trans. Bot. Soc. Ed. p. 453 (1863).
Lepidozia cupressina Pears., Hep. Brit. Isles p. 117 *pl.* 43 (1900).



1. Stem (postical view). 2. Leaf. 3. Cells.

Dioicous. In *large cream-coloured* or pale green *dense, swollen cushions*. Stems 2–4 cm long, *suberect* or procumbent, closely pinnate and frequently slightly bipinnate, the branches patent or ascending, frequently attenuate and flagelliferous at the apex, postical flagella few, rhizoids scarce and almost confined to the flagella. Leaves *closely imbricate*, patent, *very convex*, somewhat obliquely inserted, quadrate-*orbicular*, the antical base *semi-cordate* and *usually crossing the stem*, 4-lobed, occasionally 5-lobed, to a third or nearly one half, lobes narrowly triangular, acuminate, *strongly incurved*, *8–12* cells wide at base; cells 22–28 μ, quadrate-hexagonal, walls *considerably thickened*, especially at the angles; cuticle slightly hyaline-papillose. Underleaves large, patent, roundish-quadrate, 4-lobed to $\frac{1}{3}$–$\frac{1}{2}$, lobes narrowly lanceolate, *acuminate*, incurved. ♀ inflorescence on short postical branches. Involucral bracts much larger than the

leaves, hyaline, broadly orbicular or oblong-rotund, $\frac{1}{5}$–$\frac{1}{4}$ divided into 3–5 irregular lobes, the sinus acute, lobes narrowly ovate to subulate, subobtuse to acute; bracteole oblong-quadrate, 4-lobed. Perianth cylindrical-fusiform, plicate above, the mouth contracted. Androecia on very short postical branches proceeding from the stem and occasionally from near the end of the branches, bracts hyaline, in 5–6 pairs, closely imbricate, complicate-concave, $\frac{1}{4}$–$\frac{1}{3}$ divided into 2 or occasionally 3 triangular, apiculate and incurved lobes, with frequently an antical lobe at base; bracteole oval-oblong, 3-lobed. Antheridia 1–2, globose, pale brown, shortly pedicellate.

var. **minor** Macv., nov. var.

In compact greenish-grey patches. Stems *1–2 cm* long, flagella of lateral branches usually long and numerous, leaves *seldom crossing the stem*, 4-lobed, the lobes *4–8 cells* wide at the base, leaves of branches frequently 3-lobed, *cells smaller*, 16–23 μ in diam.

HAB. Moist, shady, rocky banks.

DISTRIB. Cornwall to Shetland, usually near the coast, rare; Ireland. Var. *minor*, Long Crag, Wyresdale, Lancashire, 1902 *(J. A. Wheldon)*; near Snaefell, Isle of Man, 1902 *(H. Beesley)*.

The large swollen cushions of this species, usually cream-colour when growing, are quite unlike *L. reptans*, which is the only species which could be mistaken for it; in herbaria it usually turns reddish or yellowish-brown. It is a larger plant than *L. reptans*, more regularly pinnate, branches more frequently flagelliferous, the stem hidden by the leaves, leaves not rarely 5-lobed, the lobes longer but with a broad base, and it is dioicous.

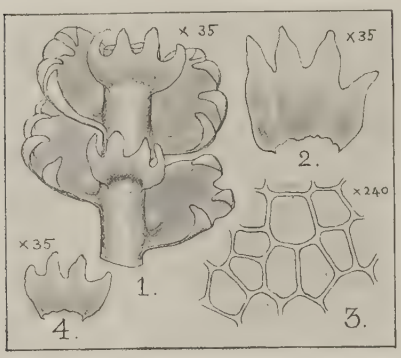
The branches are frequently curved downwards at the apex; the flagelliferous apex of the branches is occasionally pinnate, and postical flagella occur on the branches as well as on the stem. The shape of the involucral bracts varies a good deal, as the plant is always sterile; the cells of the bracts are long and rectangular, thin-walled and hyaline. The ♂ plant is common; the ♀ much less so and always? in separate tufts; perianths are very rare.

This species almost invariably forms compact tufts; a very rare form occurs in Moidart, West Inverness, *f. laxa*,—*tall* to 6 cm or more, *robust*, erect, or as *scattered stems or loosely tufted among mosses*, stem more distantly pinnate, branches rather longer and the leaves less closely imbricated. This grows on rocky banks among *Hypnum Schreberi*, etc., in company with *L. Pearsoni*, the compact form not being in the immediate neighbourhood. The var. *minor* is a stouter plant than any form of *L. reptans*, the leaves more orbicular, very convex, and the lobes usually broader at base.

197. Lepidozia reptans (L.) Dum.

Jungermannia reptans L., Sp. Pl. p. 1133 (1753).
Pleuroschisma reptans Dum., Syll. Jung. p. 69 (1831).

Lepidozia reptans Dum., Rec. d'obs. p. 19 (1835).
Herpetium reptans Nees, Eur. Leb. III p. 31 (1838).



1. Stem (postical view). 2. Leaf.
3. Cells. 4. Underleaf.

Monoicous. In *loose*, less frequently compact, *green* patches, or scattered among mosses. Stems 1·5–3 cm long, *prostrate* or with the apex ascending, loosely pinnate and occasionally slightly bipinnate, branches patent, sometimes flagelliferous at the apex, postical flagella long, mostly near base of stem; rhizoids somewhat numerous below, scarce above. Leaves approximate to imbricate, patent, convex, obliquely inserted, *almost quadrate*, the antical base rounded but *not semi-cordate* and only crossing *half the stem*, 3–4-lobed to $\frac{1}{3}$, lobes triangular, acute or subobtuse, incurved, 4–8 cells wide at base; cells 22–30 μ, quadrate-hexagonal, walls *slightly* thickened, rather more so at the angles; cuticle nearly smooth. Underleaves patent, quadrate, 4-lobed to $\frac{1}{4}$–$\frac{1}{3}$, lobes short, obtuse or subacute, incurved. ♀ inflorescence on short postical branches. Involucral bracts much larger than the leaves, hyaline, rotund-ovate, the apex irregularly 3–6-dentate, the teeth acute; bracteole broadly oval, irregularly dentate. Perianth hyaline, cylindrical-fusiform, plicate at the apex, the mouth contracted, inciso-lobate, denticulate. Capsule cylindrical-oblong, yellowish-brown, normally of 4, but occasionally of 3, layers of cells, the innermost with numerous semi-annular thickenings. Spores 11–14 μ, yellowish-brown, thickly papillose. Elaters reddish-brown, bispiral. Androecia on very short postical branches proceeding from the stem and branches, bracts hyaline, in 4–8 pairs, closely imbricate, complicate-concave, $\frac{1}{3}$ bilobed with frequently an antical tooth, lobes subacute. Antheridia generally solitary, oval-globose, brown, shortly pedicellate.

var. tenera (Hüben.) Nees, Syn. Hep. p. 205 (1844).

Jungermannia reptans γ tenera Hüben., Hep. Germ. p. 216 (1834).
Herpetium reptans δ tenerum Nees, Eur. Leb. III p. 33 (1838).

In erect scattered stems among mosses. Stems elongate, *very slender*, pinnate, the branches frequently flagelliferous, *leaves very distant*,

spreading, 3-lobed or occasionally 4-lobed, slightly convex or *flat with the apex of the lobes incurved*, the lobes *longer and narrower*, leaves of branches 3-lobed, occasionally 2-lobed, flat, $\frac{1}{2}$–$\frac{1}{3}$ divided, the lobes subulate, underleaves of branches 3-lobed, rarely 4-lobed; cells translucent, the walls thin.

var. julacea Nees, Syn. Hep. p. 205 (1844).

Herpetium reptans γ julaceum Nees, Eur. Leb. III p. 33 (1838).

Very small; in compact dark green patches. Stems to 1 cm long, *intricate*, *bipinnate*, the ultimate branches short, *obtuse and frequently rooting at the apex but not flagelliferous*, leaves small, approximate, strongly convex, 3-lobed, the lobes *short*, broad and *frequently obtuse*, underleaves 3-lobed.

Hab. Moist banks, stumps and sandstone rocks. Var. *tenera*, marshes and wet banks. Var. *julacea*, sandstone rocks and decaying logs.

Distrib. N. to Shetland, common; Ireland. Fr. April–August.

The monoicous inflorescence is the most certain character to distinguish this from *L. pinnata* and from *L. Pearsoni*. The leaves are much less convex, and the lobes shorter than in *L. pinnata*. They are also less imbricate and do not cover the stem as is usually the case in that species, the underleaves have shorter and less incurved segments; it seldom forms compact patches and never forms swollen cushions.

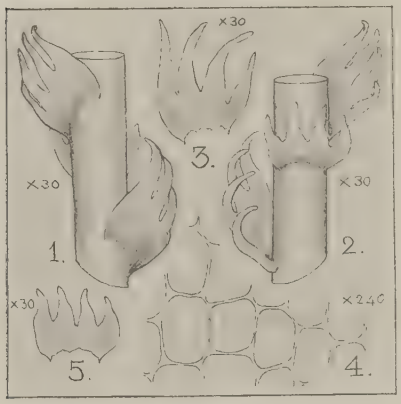
The plant varies considerably in size, being sometimes very small as in the var. *julacea*. The var. *tenera* has the habit of *L. Pearsoni*, but is generally more slender and smaller in every way. The perianth is two cells thick at the base and varies from 1–2 cells thick at the middle. The male inflorescence sometimes occurs also on the flagelliferous parts of the lateral branches.

198. Lepidozia Pearsoni Spruce

Lepidozia Pearsoni Spruce, Journ. Bot. p. 34 (1881); Pears., Hep. Brit. Isles p. 121 *pl.* 45 (1900).
Lepidozia Wulfsbergii Lindb., Soc. F. Fl. Fenn. (1882); Bot. Notis. (1882); Kaal., Dist. Hep. Norv. p. 131 (1893).

Dioicous. In *scattered stems among Sphagnum* or other erect mosses, or less frequently in loose patches, pale green or yellowish-green in colour. Stems *3–6* cm long, filiform below, thicker above, flexuous, *erect* or procumbent, loosely pinnate and occasionally slightly bipinnate, branches ascending, frequently flagelliferous at the apex, *postical flagella absent or scarce;* rhizoids almost absent except at base of stem and on the flagella. Leaves *greatly distant*, *erecto patent*, convex, obliquely inserted, distinctly longer than broad,

rather narrowly quadrate, 3-4, rarely 5–6-lobed to $\frac{1}{2}$–$\frac{2}{3}$, *lobes narrowly lanceolate, acuminate*, incurved, 3–7 cells wide at base; cells 22–30 μ, quadrate-hexagonal, walls slightly thickened, especially at the angles; cuticle smooth. Underleaves patent, rotund-quadrate, 4–5, rarely 6-lobed to the middle, lobes narrow, acute, incurved. ♀ inflorescence on short postical branches. Involucral bracts much larger than the leaves, hyaline, cordate-ovate to ovate, shortly 3–4-lobed, lobes narrowly lanceolate, acuminate; bracteole 3–4-lobed, entire or irregularly denticulate. *Androecia at the end of the long lateral branches*, seldom on short postical branches, *narrowly spicate*, bracts hyaline, in 4–10 pairs, closely imbricate, complicate-concave, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, with occasionally an antical tooth, lobes narrow, acuminate, slightly incurved. Antheridia solitary, oval, shortly pedicellate.



1. Stem (antical view). 2. Do. (postical). 3. Leaf. 4. Cells. 5. Underleaf.

HAB. Among Sphagnum and other erect mosses on moist banks in well sheltered ground.

DISTRIB. Wales to Orkney, frequent on the west side of the country, rare elsewhere; Ireland.

This species can generally be known in the field from *L. reptans* by its long slender appearance, usually growing erect among *Sphagnum*, or less frequently among *Dicranum scoparium* or other erect mosses. Where it forms patches, it can also usually be recognised by its slender habit; but tall, lax forms of *L. reptans* are occasionally seen, and although one may have little doubt in most cases as to the species, it may be said that the inflorescence is the only certain distinguishing character. Besides the dioicous inflorescence, other characters of this species are the distant, erecto-patent leaves, distinctly longer than broad, narrower and more deeply lobed, the lobes narrower and more acuminate, the more deeply lobed underleaves with the lobes narrower and more acute, the infrequency of postical flagella, and the androecium being usually at the end of a lateral branch; the last character is easily noted and is almost, though not quite, sufficient in itself. The androecium is also not rarely found on a short postical branch as in *L. reptans*: postical flagella and a postical branch are occasionally to be seen towards the apex of the stem.

The ♂ and ♀ plants are always in separate tufts, as far as is known, and usually in different stations. The ♂ is much more common than the ♀; the latter is usually a stouter plant and is the *L. Wulfbergii* of the Scandinavian botanists.

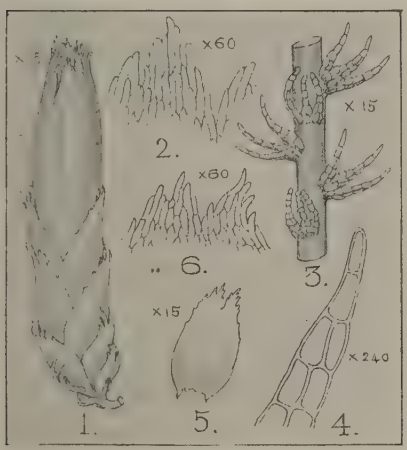
Subgen. **Microlepidozia** Spruce

Micro-Lepidozia Spruce (excl. *Teleranea*), Hep. Amaz. et And. p. 359 (1885). *Microlepidozia* Schiffn. in Engl. and Prantl, Nat. Pflanz. I 3 p. 103 (1895).

Plants small. Postical flagella present in some species. Leaves transversely inserted, deeply partite, the undivided base about 4 cells broad; segments subulate. Perianth thin, the mouth laciniate-ciliate, rarely only denticulate.

199. Lepidozia trichoclados K. Müll.

Jungermannia setacea Hook., Brit. Jung. Synopsis p. 8 et Suppl. *pl.* 1 (1816). *Lepidozia trichoclados* K. Müll., Hedwigia 38 p. 197 *pl.* 8 f. 1–13 (1899).



1. Fertile plant. 2. Mouth of perianth. 3. Stem (postical view). 4. Cells (apex of leaf). 5. Bract. 6. Apex of bract.

Dioicous. In dark yellowish-green *large swollen cushions on moist peaty banks*, less frequently in small tufts or scattered among mosses. Stems 2–4 cm long, filiform, erect or ascending, *usually regularly bipinnate* or pinnate, but not seldom only irregularly pinnate, branches patent or horizontal, sometimes flagelliferous at the apex, flagella few; rhizoids scarce on the lower part of stem and on the flagella, almost absent above. Leaves distant on the stem, generally approximate on the branches, usually *widely spreading*, but those on the main stem sometimes erecto-patent or suberect, somewhat incurved, frequently with small portions of stem and branches having closely imbricate leaves; leaves transversely inserted, deeply trifid, the segments two cells wide below, the apex of a single series of 1–3 cells, the terminal cell acute; cells 18–25 μ long, quadrate, walls slightly and equally thickened; cuticle smooth or verruculose. Underleaves resembling the leaves but smaller, trifid, on the branches frequently bifid, segments commonly unequal. ♀ inflorescence on a short postical branch. Involucral bracts much

larger than the leaves, *ovate* to oblong-ovate, *the apex dentate* or very shortly laciniate-lobed. Perianth cylindrical-fusiform, the mouth contracted, *denticulate, not becoming wide* after the exsertion of the capsule. Capsule oval, yellowish-brown, on a long pedicel, inner wall with semi-annular thickenings. Spores 13–14 μ, yellowish-brown, thickly verrucose. Elaters short, bispiral, reddish-brown. Androecia usually on short postical branches, bracts in 4–5 pairs, closely imbricate, strongly concave, bifid to below the middle, *segments dentate*, acuminate, greatly incurved. Antheridia solitary, obovate-oval.

HAB. On moist peaty banks.

DISTRIB. N. to Orkney, common in the western subalpine region where peat is present, uncommon to rare in the central and eastern districts. Fr. August–Nov., frequent.

Can usually be recognised in the field from *L. setacea* by its large swollen cushions; it also most commonly occurs on moist peaty banks while the other is most often found in peat-mosses, but neither habit or habitat is distinctive of either. The present species is in general a taller plant and the leaves are more spreading than in the common form of *L. setacea*; the leaf-cuticle is smooth or finely verruculose instead of being rather strongly verruculose as in the other. The two species can, however, only be definitely separated by the bracts or perianth. In fertile plants the bracts are very distinctive, being ovate, and dentate only at the apex, or at most very shortly laciniate; in sterile specimens they are frequently rather more deeply dentate or laciniate, but never with three or four deep laciniae as in *L. setacea*. The bracts of the fertile plant do not vary very much, but in sterile plants of this and of *L. setacea* they do so considerably. The denticulate mouth of the perianth is also distinctive, and as perianths are frequent, especially in autumn—to be looked for towards the base of the stem—this species can usually be known without difficulty. The male bracts also differ from those of the other, being dentate.

Male plants are more frequent than in *L. setacea* and occur in the same tuft as the female.

200. Lepidozia setacea (Web.) Mitt.

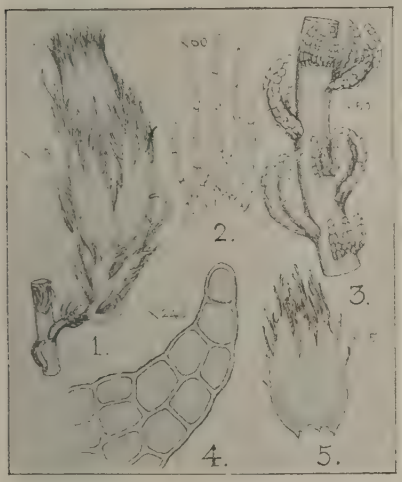
Jungermannia setacea Web., Spicil. Fl. Götting. p. 155 (1778); Hook., Brit. Jung. *pl.* 8 (1812).

Blepharostoma setaceum Dum., Rec. d'obs. p. 18 (1835).

Lepidozia setacea Mitt., Proc. Journ. Linn. Soc. 5 p. 103 (1841); Carr., Trans. Bot. Soc. Ed. p. 453 (1863); K. Müll., Hedwigia 38 p. 196 *pl.* 8 f. 14–16 (1899).

Dioicous. In *small dark-green* compact patches, or scattered among mosses. Stems 1–2 cm long, filiform, ascending or suberect, irregularly pinnate and frequently bipinnate, branches erecto-patent or patent, flagella few, long, most commonly confined to near base of stem; rhizoids numerous on lower part of stem and on the flagella, scarce above. Leaves distant on the stem, approximate

to imbricate on the branches, hardly twice as long as the diameter of the stem, *suberect and incurved*, less frequently widely spreading, transversely inserted, *deeply trifid*, or occasionally quadrifid, to within two or three cells of the base, the antical margin frequently with a tooth at base, the base 4–5 cells wide, *the segments two cells wide except at the apex*; cells 18–23 μ long × 13–15 μ broad, quadrate, walls slightly and equally thickened; cuticle verruculose. Underleaves resembling the leaves but rather smaller, quadrifid or trifid to near the base, the segments slightly incurved. ♀ inflorescence on a very short postical branch. Involucral bracts much larger than the leaves, *deeply divided into 3–4 lanceolate, acuminate, dentate, or laciniate segments*. Perianth almost cylindrical, the mouth contracted but *becoming wide* after the exsertion of the capsule, *ciliate*, cilia 1–3 cells long. Capsule oval, reddish-brown. Spores 10–14 μ, globose to oval-globose, usually obtusely angular, thickly verrucose, yellowish-brown. Elaters 100–170 μ long and 8–13 μ broad, reddish-brown. Androecia on short postical branches, less frequently at the end of a lateral branch, bracts in 4–5 pairs, larger than the leaves, closely imbricate, strongly concave, 2–3-lobed to the middle with generally a tooth at the antical base, the laciniae entire or sometimes with a 1-celled tooth. Antheridia solitary, globose, pale green, shortly pedicellate.



1. Fertile plant 2. Mouth of perianth. 3. Stem (postical view). 4. Cells. 5. Bract.

var. **sertularioides** (Hüben.) Cooke, Handb. Brit. Hep. p. 91 (1894).

Jungermannia setacea Web. *β sertularioides* Hüben., Hep. Germ. p. 51 (1834).

Elongate, stems subpinnate to bipinnate, *leaves distant* on the stem and incurved, frequently spreading on the branches. Comprising two forms—(1) Dark green, in small patches frequently

loosely tufted, stems *irregularly subpinnate*, leaves on the branches *imbricate and strongly incurved*. (2) Pale green, taller and more rigid, frequently in large, compact patches resembling *L. trichoclados*, stems *pinnate and bipinnate*, leaves on the branches *distant, widely spreading* but most commonly slightly incurved at the apex, cells of stem and leaves more translucent.

HAB. Moist peaty soil, seldom on loamy banks and roots of trees.

DISTRIB. N. to Shetland, common on moors; Ireland. Fr. July–Sept., rare.

With the exception of *L. trichoclados* this species can only be confused with *Blepharostoma trichophyllum*, but the latter can be known at sight by its pale green colour and the segments of the leaves larger and always widely spreading; these are also one cell broad throughout, while in *L. setacea* they are two cells broad at the base and for a part of their length, at least on the stem and principal branches.

The form (2) of var. *sertularioides*, especially when occurring on subalpine banks, has quite the habit and appearance of *L. trichoclados*, and can only be separated from it with certainty by the different bracts and perianths. In this form the male bracts are frequently to be seen at the side of long lateral branches; they are in globose heads at the time of maturity of the antheridia, afterwards the head lengthens. This form is perhaps the var. *tamariscina* Nees in *Eur. Leb.* II p. 296.

The var. *Schultzii* Hüben. is the plant of dry ground. It is very small, irregularly branched, leaves strongly incurved, 2-3-lobed, the lobes short and broad.

Sterile ♀ plants are common, perianths are uncommon and fruit is very rare; the ♂ plant is much less common than the ♀.

L. sylvatica Evans. "Rhodora" p. 186, 1904, a North American species which has also been recorded by Douin from the Continent, has the mouth of the perianth ciliate as in *L. setacea*, but it differs in the involucral bracts being ¼ bifid with the segments denticulate or ciliolate. The underleaves also frequently have one or two of their segments reduced to 1–2 cells in length, owing to their being aborted by a hyaline papilla. Evans remarks that when papillae occur in *L. setacea* the segments never show so much reduction.

SUBFAMILY **Ptilidioideae**

Leaves incubous or transverse, seldom succubous, bi–multifid, *frequently ciliate or ending in hair-like points*. Underleaves always present and *nearly resembling the leaves in shape and size*. ♀ inflorescence *terminal on the stem or on lateral branches, never on postical branches*; bracts polyphyllous. Perianth scarcely compressed, 3–10-plicate, contracted or truncate at the mouth, free or adnate with the innermost bracts, sometimes absent. Capsule usually shortly pedicellate, ovate with straight valves or cylindrical with twisted valves.

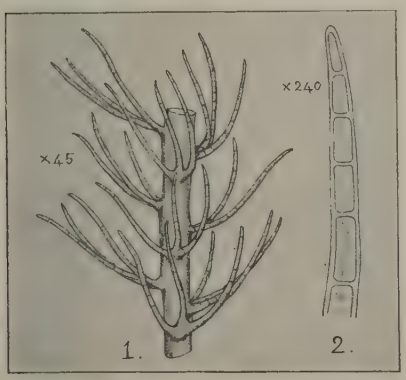
LII. BLEPHAROSTOMA Dum.

Jungermannia sect. *Blepharostoma* Dum.. Syll. Jung. p. 65 (1831).
Blepharostoma Dum., Rec. d'obs. p. 18 (1835).
Chaetopsis Mitt., Journ. Linn. Soc. 8 p. 53 (1865).
Blepharostoma subgen. *Chaetopsis* Schiffn. in Engl. and Prantl, Nat. Pflanz. I 3 p. 105 (1895).

Plants small. Stems slender, with lateral branches. Leaves almost transversely inserted, *divided nearly to the base into 2–5 capillary segments composed of a single series of cells throughout. Underleaves resembling the leaves* but slightly smaller and frequently with fewer segments. ♀ inflorescence terminal on the stem or branches. Involucral bracts tristichous, free from the perianth, larger than the leaves and with the laciniae furcate or spinous. Perianth oblong to cylindrical, trigonous above with the third angle postical, of one layer of cells, the mouth contracted, ciliate. Capsule oval, 4-valved, of two layers of cells, the inner with semi-annular thickenings. Elaters bispiral. Androecia spicate, terminal on branches, seldom hypogynous, bracts complicate-concave, with the laciniae often furcate, usually monandrous.

201. Blepharostoma trichophyllum (L.) Dum.

Jungermannia trichophylla L., Sp. Pl. p. 1135 (1753).
Blepharostoma trichophyllum Dum., Rec. d'obs. p. 18 (1835).



1. Stem with leaves and underleaves.
2. Cells.

Paroicous and monoicous, rarely dioicous. In scattered stems among mosses or less frequently in small compact patches, *pale green* in colour. Stems 8–20 mm long, filiform, flexuous, ascending or procumbent, usually sparingly branched, the branches lateral; rhizoids long and colourless, rather scarce. Leaves somewhat distant, *widely spreading*, a few sometimes suberect, almost transversely inserted, *divided nearly to the base into 3–4 rigid setaceous segments composed*

of 8–12 uniseriate cells; cells very variable in length, averaging about 28 × 40 μ, narrowly quadrate, the walls thickened; cuticle striate-granulate. Underleaves transversely inserted, *resembling the leaves* but rather smaller, 2–3-partite on the branches. ♀ inflorescence terminal on the stem and branches. Involucral bracts larger than the leaves, deeply divided into *several forked laciniae* which are 2–3 cells broad at base, otherwise uniseriate, the base of bract being undivided up to 4–6 cells high; bracteole rather smaller. Perianth longly exserted, cylindrical-clavate, obtusely trigonous above, the mouth slightly contracted, with rigid and somewhat connivent cilia, *the cilia to 7 cells long*. Capsule oval, purplish-brown, the wall bistratose, inner layer with thick, mostly incomplete, semi-annular thickenings. Spores 9–11 μ, brown, minutely verruculose. Elaters bispiral, reddish-brown. ♂ bracts immediately or some distance below the involucral bracts, or at the apex of the branches, and resembling the bracts but with a narrow basal portion 2 cells high and with the laciniae commonly only once furcate. Antheridia solitary, rarely in pairs, oval-globose, small, on a pedicel of nearly equal length, without paraphyses.

Hab. On moist rocky banks and occasionally on stumps.

Distrib. N. to Shetland, generally distributed in subalpine and alpine districts, common in the Highlands; Ireland. Fr. April–July.

The pale green colour of this plant is conspicuous when in patches, quite unlike that of the dark green *Lepidozia setacea* and *L. trichoclados*; the segments of the leaves are longer than in either of these and are always widely spreading except at the apex of the branches; under the microscope, the segments being composed of a single series of cells throughout their whole length will readily distinguish it.

The stem leaves are commonly quadripartite while those on the branches are frequently tripartite, and on slender stems rarely bipartite. The leaves are divided to the bottom cell and usually about half-way down that cell. The segments are rarely furcate on the leaves, but are commonly so on the bracts.

The ♂ bracts are frequently to be seen at the apex of the branches. As however the species appears to be strongly proterandrous, it is possible that archegonia would be developed later on in those cases where the antheridia only can be seen; in this case the plant would be always paroicous.

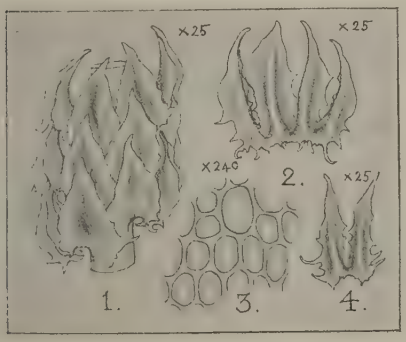
LIII. CHANDONANTHUS Mitt.

Chandonanthus Mitt. in Hook., Handb. New Zeal. Fl. 2 p. 750 (1867).
Blepharostoma Lindb., Musc. Asiae Bor. p. 28 (1889).

Plants generally large and *rigid*. Stems rigid, simple or with few branches, the branches lateral. Leaves imbricate, nearly transversely inserted, semi-amplexicaul, dentate or *spinous-dentate at the base*, *deeply 3–4-lobed*, rarely 2-lobed, lobes entire or variously dentate. *Underleaves resembling the leaves in appearance* but rather smaller and *deeply 2-lobed*. Perianth terminal, with one innovation, *deeply multiplicate*, the mouth slightly contracted, ciliate or dentate. Calyptra thin, free, surrounded at the base by the sterile archegonia.

202. Chandonanthus setiformis (Ehrh.) Lindb.

Jungermannia setiformis Ehrh., Beitr. 3 p. 40 (1785) ; Hook., Brit. Jung. *pl.* 20 (1812).
Anthelia setiformis Dum., Rec. d'obs. p. 18 (1835) ; Cooke, Handb. Brit. Hep. p. 74 (1894).
Chandonanthus setiformis Lindb., Musc. Scand. p. 5 (1879).
Blepharostoma setiforme Lindb., Musc. Asiae Bor. p. 28 (1889).



1. Stem. 2. Leaf. 3. Cells. 4. Underleaf.

Dioicous. In large *reddish-yellow* to brownish-yellow compact patches. Stems 2·5–5 cm long, filiform, brown, *rigid and brittle*, *erect* or procumbent, sparingly branched, the branches lateral, short, or long and erect, sometimes attenuate and microphyllous at the extremity; rhizoids colourless, scarce and almost confined to base of stem and apex of the microphyllous branches. Leaves *densely imbricated*, nearly transversely inserted, semi-amplexicaul, broader than long, *the base patent*, *coarsely dentate on the margins*, the teeth usually reflexed, *deeply divided into 3–4 erect*, *oblong-lanceolate* subacute segments, *the margins recurved* and more or less dentate at the base ; cells 18–23 μ, oblong-quadrate, walls considerably thickened especially at the angles ; cuticle thick, slightly granulate. *Underleaves resembling the leaves* but rather smaller, usually *deeply 2-lobed*, *laciniate or coarsely dentate at the base*. ♀ inflorescence terminal but appearing as if lateral through an innovation. Involucral bracts deeply 4-lobed, resembling the leaves but larger, with the basal portion higher and spinous-ciliate at the base, the lobes lanceolate and *longly acuminate*, coarsely dentate

towards the base; bracteole bilobed to the middle, laciniate-ciliate at the base, the lobes triangular-lanceolate, longly acuminate, dentate-ciliate at the base. Perianth exserted half its length beyond the bracts, oblong, *7–10-plicate to the base*, the mouth slightly contracted, shortly lobed and ciliate, the cilia 3–6 cells long, with a few 1-celled teeth occasionally between. Androecium at the middle of the main stem, bracts in several pairs, resembling the leaves but less deeply lobed. Antheridia 2–3, large, mixed with paraphyses.

var. **alpinus** (Hook.) Kaal., De Dist. Hep. Norv. p. 227 (1893).

Jungermannia setiformis β alpina Hook., Brit. Jung. *pl.* 20 f. 1, 3 & 4 (1812).
Jungermannia filum Dum., Syll. Jung. p. 64 (1831).
Anthelia filum Dum., Hep. Eur. p. 98 (1874); Cooke, Handb. Brit. Hep. p. 75 (1894).
Blepharostoma subintegrum Lindb., Journ. Bot. p. 195 (1887).
Blepharostoma filum Lindb., Musc. Asiae Bor. p. 28 (1889).

Smaller and slender, more decumbent and with more rhizoids, leaves *less closely imbricate*, less dentate at base, *more frequently only 3-lobed*, the lobes more ovate and *usually entire at base.*

var. **nemoides** Kaal., Kgl. Norsk. Vidensk. Sels. Skrift. No. 7 p. 23 (1910).

Dark brown to dark yellowish-brown, *very small and slender*, about 1 cm long and ·3–·5 mm broad, prostrate or nearly so, leaves less imbricate, concave, *entire or with a tooth at base*, *2–lobed*, seldom 3-lobed, the lobes connivent, entire.

Hab. On rather dry granite rocks in alpine and subalpine regions.

Distrib. East Inverness to Aberdeen, descending to 1800 ft. alt., rare; var. *alpinus*, West Inverness and Forfar to Caithness, descending to 900 ft. alt.; var. *nemoides*, Aberdeenshire.

The type is a robust plant forming large erect or suberect reddish-yellow patches; it is rare with us, being much less frequent than the var. *alpinus*. These can be usually separated without difficulty in this country, but intermediate forms are sometimes seen, and they are common in Scandinavia. The robust appearance of the typical plant is owing to the leaves spreading almost horizontally from the stem, then becoming erect and closely imbricated; this makes the plant appear to be stout although the stems are filiform.

There is a single erect innovation below each perianth, and this may be repeated several times, each innovation appearing as if it were a continuation of the stem, the perianth thus looking as if cladogenous. Perianths are rare in Britain, the var. *alpinus* being nearly always without them; they are practically 1-stratose throughout, only the base being 1-2-stratose. The ♂ plant appears to be very rare; the description of the androecium is taken from Schiffner.

This species will not probably be mistaken; the colour, the 3–4-lobed imbricate leaves dentate at base, and the rather broad lobes frequently channelled in the middle and with the margins recurved, are unlike any other species. The

less imbricate leaves of the var. *alpinus* allow the tooth at the base of the antical margin to be readily seen without dissection; this tooth is not present in all the leaves, but is in most.

The var. *nemoides* is the extreme form of the species, and is connected by intermediate forms with the var. *alpinus*. As Kaalaas remarks, it is of about the size of *Nowellia curvifolia*.

LIV. ANTHELIA Dum.

Anthelia Dum., Rec. d'obs. p. 18 (1835).
Chandonanthus Mitt. in Hook., Handb. New Zeal. Fl. 2 p. 750 (1867).

Plants small, *densely caespitose*. Stems firm, unequally pinnate, the branches lateral, flagella absent. Leaves almost transversely inserted, small, *carinate-concave*, *2-lobed* to the middle or below, entire or denticulate on the margin. *Underleaves resembling the leaves*. ♀ inflorescence terminal on the stem or branches. Involucral bracts *adnate to the base of the perianth*. Perianth thin, somewhat frontally compressed, deeply unisulcate dorsally and 2–3-carinate ventrally, 8–10-plicate at the slightly contracted and denticulate mouth. Calyptra with *the sterile archegonia on its surface*. Capsule shortly pedicellate, bistratose, the inner wall with semi-annular thickenings. Antheridia large, solitary.

Stephani considers that the perianth is absent in this genus, and that what is commonly named the perianth is a concrescence of the involucral bracts and bracteole, to which the calyptra is adnate in its lower half.

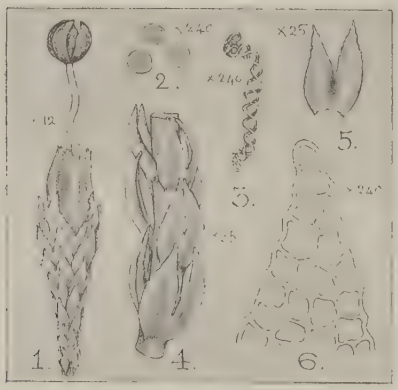
{ Dioicous; perianth oblong.....*203. julacea*
{ Paroicous; perianth ovate.....*204. Juratzkana*

203. Anthelia julacea (L.) Dum.

Jungermannia julacea L., Sp. Pl. p. 1135 (1753); Lightf., Fl. Scot. p. 785 (1777); Hook., Brit. Jung. *pl.* 2 (1812).
Anthelia julacea Dum., Rec. d'obs. p. 18 (1835).

Dioicous. In large compact *dark green* or dark yellowish-green patches, frequently becoming *glaucescent when dry*. Stems 1-3 cm long or more, matted below, brown, erect or procumbent, much branched, branches lateral, short, ascending or erect; rhizoids colourless, numerous below, scarce above. Leaves *densely imbricate and erecto-appressed*, suberect and *incurved*, nearly transversely inserted, ovate, channelled and somewhat concave, $\frac{2}{3}$ *bilobed*, sinus narrow,

acute, *lobes lanceolate* or subovate-lanceolate, acute or acuminate, crenate-dentate towards the apex, the apical cell frequently hyaline, margins more or less broadly recurved; cells greatly unequal in size, averaging 18–28 μ in the middle of the lobes, *quadrate*-hexagonal, the marginal smaller and sub-quadrate, *all the cells strongly and equally thickened;* cuticle nearly smooth. *Underleaves resembling the leaves*, slightly or hardly smaller. ♀ inflorescence terminal on the stem and branches, frequently with an innovation. Involucral bracts much larger than the leaves, deeply channelled, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, sinus acute and closed, lobes erose-dentate, acute, broadly hyaline; bracteole $\frac{1}{3}$ bilobed, erose-denticulate, acute or truncate at the apex. Perianth exserted to half beyond the bracts, *oblong*, deeply plicate from the middle upwards, the mouth hyaline, unequally denticulate. Capsule globose-oval, shortly pedicellate, inner layer with numerous semi-annular thickenings. Spores 14–15 μ, reddish-brown, finely verruculose. Elaters 8–9 μ thick, short, *bispiral*, reddish-brown. Androecium at the end or middle of the branches, bracts in several pairs, closely imbricate, slightly ventricose at base, larger than the leaves and less deeply bilobed, the lobes ovate, acute, somewhat unequal. Antheridia large, single, without paraphyses.



1. Fertile plant. 2. Spores. 3. Elater. 4. Stem. 5. Leaf. 6. Cells.

var. **gracilis** Hook., Brit. Jung. No. 2 β fig. 15.

Pale yellowish-green or glaucescent, stems, *2·5 4·5* cm long, *slender*, frequently with long, erect branches, *leaves approximate*, not imbricate, *patent or erecto-patent with the upper part incurved.*

Hab. On wet stony places, peaty ground, wet rocks and damp footpaths in the subalpine and alpine regions.

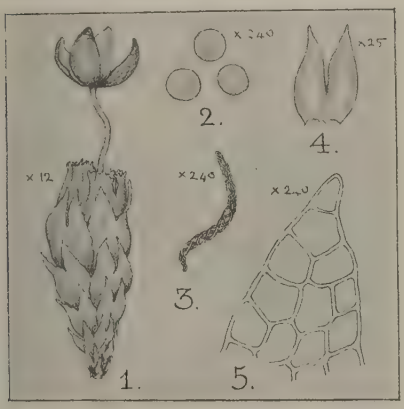
Distrib. Wales to Shetland, ascending to 4400 ft. alt., and descending in the West Highlands to sea-level; Ireland. Var. *gracilis* on wet ground in the higher mountains. Fr. June–Aug.

This species was sometimes confused by the older botanists with *Gymnomitrium concinnatum*, but this is hardly possible at the present time, as the plants have nothing in common except sometimes the colour, and the imbricate, appressed leaves. The leaves of *Anthelia* are similar to the underleaves, so that they appear as if in three rows; in no other genus with deeply bilobed, appressed and imbricate leaves, does this occur.

This is the most conspicuous hepatic on our Highland mountains, as it forms extensive patches on wet rocks or among stones in marshy places, dark green or yellowish-green in colour or with the apex glaucescent when moist, and more or less glaucescent when dry. It descends to sea-level in subalpine districts, especially on the west coast, and in this case is found usually on moist soil on stony footpaths and roadsides, where it frequently fruits; the large masses on wet alpine rocks are mostly sterile. It is not a rarely fruiting species, but is much less frequently fertile than *A. Juratzkana*.

204. Anthelia Juratzkana (Limpr.) Trevis.

Jungermannia nivalis Swartz in Wahl., Fl. Carp. p. 363 (1814)?
Jungermannia Juratzkana Limpr., Krypt. Fl. Schles. p. 289 (1877).
Anthelia Juratzkana Trevis., Mem. Ist. Lomb. 3 p. 416 (1877); Spruce, On Ceph. p. 82 (1882); Pears., Hep. Brit. Isles p. 97 (1899).
Anthelia nivalis Lindb., Musc. Scand. p. 5 (1879); Kaal., De Dist. Hep. Norv. p. 232 (1893).



1. Fertile plant. 2. Spores. 3. Elater. 4. Leaf. 5. Cells.

Paroicous. Resembling *A. julacea* but smaller, the *fertile plant being usually in small patches.* Stems in fertile plant *very short*, 2–4 mm long, thickly matted below, decumbent, with several short ascending subfasciculate branches, mostly clavate towards the end; rhizoids numerous below, less so on the branches. Leaves densely imbricated and erecto-appressed, sometimes approximate on the branches and erecto-patent or incurved, the margins of lobes *less dentate or entire*; cells 21–30 μ, mostly rectangular, *more pellucid and with the walls less thickened.* Underleaves and involucral bracts as in *A. julacea.* Subinvolucral bracts larger than the leaves, broader and slightly ventricose at base, the apex of lobes denticulate. Antheridia solitary, large. Perianth *scarcely exserted beyond the bracts, ovate.* Capsule-wall with fewer

semi-annular thickenings in the inner wall. Spores *larger*, 17–20 μ. Elaters *more slender*, 6–7 μ thick, *mostly trispiral.*

Hab. On moist, bare, peaty soil and on wet rocks in the alpine region.

Distrib. From Argyll and Perth to Caithness, from 1900–4300 ft. alt. Fr. June–Aug.

Fertile plants of this species can be recognized in the field by the ovate perianths. It almost always occurs on soil when fertile, and the patches are generally small or the plants only gregarious. Being a small species it is easily overlooked in these small fertile patches, but fruit is common and can be detected with the lens. The plant is not rare on the moist bare soil of our higher hills; where the soil is gravelly and dry, it is rare or absent. Sterile plants are stated by Kaalaas to occur in large patches on wet rocks in Norway; they may also do so with us, but I have not been able to determine with certainty any of these patches as belonging to this species. The sterile plant has generally longer stems than the fertile plant.

There appears no reason to consider *A. Juratzkana* as other than a species distinct from *A. julacea*; the inflorescence, perianth, spores and elaters are constant differential characters. They cannot be separated with certainty by the vegetative characters, although *A. Juratzkana* has in general less denticulate leaf-lobes and the cell-walls much less thickened; the walls are also more equally thickened, the cells slightly larger and more pellucid.

The leaves of both our species are usually covered with fungal filaments which give them a greyish or whitish appearance.

LV. HERBERTA S. F. Gray

Herbertus S. F. Gray, Nat. Arr. Brit. Pl. 1 p. 705 (1821).
Schisma Dum., Comm. Bot. p. 114 (1822).
Sendtnera Nees in G. L. N., Syn. Hep. p. 238 (1844).

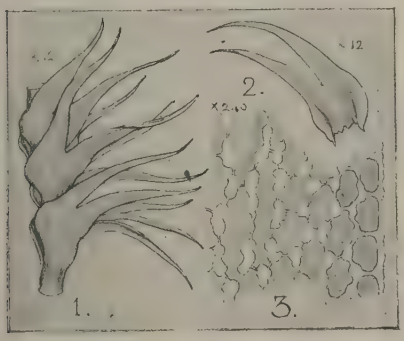
Dioicous. Plants large and rigid, *reddish-brown.* Stems arising from a slender, rhizomatous base, procumbent or erect, with few branches and innovating from below the ♀ inflorescence. Leaves incubous or almost transversely inserted, *hamato-secund*, $\frac{1}{2}$–$\frac{3}{4}$ *bilobed*, *the lobes long, narrow and acuminate*; *median cells elongate, incrassate, extending into the lobes. Underleaves resembling the leaves.* ♀ inflorescence terminal, bracts several, closely imbricate, surrounding and almost concealing the perianth. Perianth narrow, ovate-subulate, tricarinate, the mouth plicate and deeply laciniate. Capsule large, globose, 4-valved, the valves frequently bipartite. Androecia near the end of the stem or branches, bracts few, nearly resembling the leaves, but less deeply bilobed, ventricose at base, the margins strongly recurved and with papilliform teeth at the base; *bracteoles also with antheridia.* Antheridia 2–5.

A genus almost confined to the tropics, of which two species are found in Europe. The cell structure of the leaves is peculiar. The median cells are elongated and incrassate and form what Stephani names a *vitta*, as Nees had already done in the case of *Diplophyllum albicans*. This is undivided in the basal portion, and forked into each lobe. The breadth of the vitta and the height to which it extends into the lobes is used by Stephani as an important character in distinguishing the various species.

Schiffner has recently, in *Hedwigia* Vol. 50 pp. 146–162, investigated the androecia in the *Ptilioideae*. Among other points, he finds that the bracteoles of all the species of *Herberta* and *Mastigophora* which he has examined, contain antheridia, and that only in these genera does this occur. He considers that this serves as a good generic character.

√ 205. Herberta adunca (Dicks.) Gray

Jungermannia adunca Dicks., Plant. Crypt. Fasc. 3 p. 12 *pl.* 8 f. 8 (1793).
Jungermannia juniperina Swartz β Hook., Brit. Jung. pl. 4 (1812) et Suppl. *pl.* 1 (1816).
Herberta adunca Gray, Nat. Arr. Brit. Pl. 1 p. 705 (1821).
Schisma aduncum Dum., Comm. Bot. p. 116 (1822).
Sendtnera juniperina β Nees in G. L. N., Syn. Hep. p. 239 (1844).
Herberta straminea Lett (*non* Dum.), List Brit. Hep. p. 177 (1902).



1. Stem. 2. Leaf. 3. Cells.

Dioicous. In *large reddish*, seldom olive-green tufts, or as scattered stems among mosses. Stems 3–12 cm long, reddish-brown, flexuous, rigid, *erect* with the apex decurved, simple or very sparingly branched, also with small-leaved flagella arising from the stem and with 1–3 innovations from below the ♀ inflorescence; rhizoids scarce and almost confined to the base of the stem. Leaves densely imbricate, nearly transversely inserted, *rigid*, *falcato-secund* or secund, *narrowly ovate-lanceolate* and elongate, channelled with the margins broadly recurved at base, $\frac{2}{3}$–$\frac{3}{4}$ *bilobed*, sinus obtuse or acute, lobes linear-lanceolate, slightly divaricate, the whole margin entire; cells 16–23 μ, *nodular or stellate*, the marginal row subquadrate, *central cells elongate*, to 64 μ, narrow, slightly nodulose, *forming a broad band* furcate for some distance into the lobes, walls greatly thickened, nearly colourless or pale yellow, those of the central cells yellow to reddish-brown; cuticle verruculose. Underleaves resembling the

leaves. Involucral bracts *deeply channelled* with the margins recurved, bilobed, with longly acuminate lobes, ciliate and slightly laciniate from the base to slightly beyond the junction of the lobes. Androecia near the end of the stem and branches, bracts in few pairs, less deeply bilobed than the leaves, the base ventricose, with the margins broadly recurved and with papilliform teeth at base; bracteole resembling the bracts. Antheridia 2–3, oval-globose, longly pedicellate, present both in bracts and bracteole.

var. **alpina** Macv., var. nov.

Small, in dark yellowish-brown to *nearly black* loose tufts, stems 2–3 cm long, *leaves widely spreading*, sometimes squarrose, *not at all secund*, segments *shorter and broader* than in the typical plant, flat and *not acuminate*.

Hab. On moist rocky banks and rock ledges in the subalpine and alpine regions.

Distrib. Wales to Shetland, ascending to 3400 ft. alt.; Ireland. Var. *alpina*, near the summit of some of the Breadalbane hills and in Shetland, very rare.

Is generally a tall reddish plant with the habit of a *Dicranum* and unlike any other British hepatic. It forms large tufts on rock ledges and among boulders, either unmixed or with other western species and with *Bazzania tricrenata*. The bases of the leaves are densely imbricate, the recurved or spreading lobes are usually somewhat distant. Occasionally a tooth is to be seen at the base of the leaves and underleaves and on the internal margin of the base of the lobes. In the younger parts, the central portion of the stem is much darker coloured than the marginal cells.

In exposed situations this species is occasionally small, olive green to nearly black in colour, with the leaves hardly or only slightly falcate. The var. *alpina* is an extreme form, very unlike the typical plant, with spreading and nearly flat leaves. In small plants of the common form of the species the leaves are narrow and longly acuminate; in the var. *alpina* they are never longly acuminate and are much broader. Dumortier's *Schisma stramineum*, as far as it relates to Scottish specimens, is doubtless the plant of exposed situations, as we have only one species. He evidently considered it to be the same as the *Schisma Sendtneri* Nees, but that is quite a distinct species and it does not occur in our islands. The Scottish and Irish plants are identical and are found near sea-level in both countries, but as the species appears to occur rarely, if at all, in high exposed localities in Ireland, it varies less in that country.

Sterile ♀ inflorescence is frequent, but perianths have not been found in this country; the ♂ plant is rare. Hooker in *Brit. Jung.* mentions that he had received from Dickson plants with fruit from Scotland, but there was probably some mistake on Dickson's part.

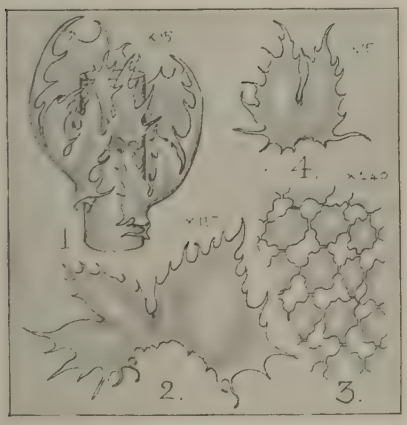
LVI. MASTIGOPHORA Nees

Mastigophora Nees, Eur. Leb. III p. 89 (1838).
Sendtnera sect. 2. *Mastigophora* G. L. N., Syn. Hep. p. 241 (1844).

Dioicous. Plants large, reddish-brown. Stems pinnate and frequently bipinnate, branches lateral, *the apices frequently attenuate and flagelliferous*. Leaves incubous, semi-amplexicaul, complicate-concave, 2–4-lobed, *spinous-dentate*. Underleaves large, but smaller than the leaves, 2–4-lobed, *spinous-dentate*. *Perianth terminal on a short lateral branch*, free, inflated, irregularly carinate, the mouth contracted, plurifid. Calyptra tender, free. Androecia on short, attenuate branches, bracts in few pairs, complicate-concave, 2–3-lobed; *bracteoles also with antheridia*. Antheridia 2–3.

206. Mastigophora Woodsii (Hook.) Nees

Jungermannia Woodsii Hook., Brit. Jung. *pl.* 66 (1814).
Blepharozia Woodsii Dum., Rec. d'obs. p. 16 (1835).
Mastigophora Woodsii Nees, Eur. Leb. III p. 95 (1838).
Sendtnera Woodsii G. L. N., Syn. Hep. p. 241 (1844).



1. Stem. 2. Leaf. 3. Cells. 4. Underleaf.

Dioicous. *In large reddish or yellowish-brown patches.* Stems *5–12 cm* long, dark orange on the older parts, pale yellow on the branches, rigid, brittle when dry, flexuous, procumbent, *pinnately and usually slightly bipinnately branched*, the branches patent then *recurved*, with a few straight and erecto-patent, all branches *attenuate* except at apex of stem, *frequently shortly microphyllous and flagelliferous at the end* and with a few long, colourless rhizoids, rhizoids elsewhere absent or nearly so. Leaves tender, approximate below, imbricate above and on the branches, semi-amplexicaul, almost transversely inserted, concave, roundish-quadrate, divided to below the middle into 4 segments, sinus rounded, the antical segment largest, *patent or erecto-patent*, semicordate-ovate,

lying on the stem and usually crossing it, with frequently a long, spinous tooth or small lobe near the base, the next two segments narrower, broadly *lanceolate and suberect, all the segments being acuminate and incurved and with the margins somewhat distantly and irregularly spinous-dentate with long, subulate teeth*, the most postical segment *very small*, more or less *incumbent*, subulate to ligulate; branch leaves composed commonly of two nearly equal segments and the small postical portion; cells 18–24 μ, *in linear series*, oblong-rotund, *stellate*, the walls greatly thickened, pale yellow; cuticle nearly smooth. Underleaves about half as large as the leaves, erecto-patent, the margins slightly recurved, $\frac{2}{3}$ bilobed, sinus rounded, lobes broadly lanceolate, acuminate, the whole margin laciniate-ciliate, the lacinae at base recurved.

HAB. On moist rock ledges and steep grassy slopes in the alpine region.

DISTRIB. Dumbarton and Perth to West Sutherland, almost confined to the western watershed, from 1600–2300 ft. alt., rarely descending to 1000 ft. alt.

The only plant which bears any resemblance to this is *Ptilidium ciliare*, but the *Mastigophora* can be at once distinguished in the field by its larger size and by the longer, more slender and attenuate branches. In *P. ciliare* the branches are not attenuate, nor are they ever flagelliferous at the end. With a lens, the leaves of the present plant can be seen to be spinous-dentate, and in the other to be ciliate. On closer examination the two species bear little resemblance to one another. *Mastigophora* generally forms large compact patches on rock ledges and among boulders in moist, but not wet, places. When on grassy banks it is usually mixed with other western species as *Pleurozia*, *Anastrepta* and *Jamesoniella Carringtoni*.

The leaves are tender and rather translucent, the stem being distinctly seen through them; in fact, the part of the leaf in front of the stem is difficult to see except on the branches. The antical lobe lies on the stem and usually slightly crosses it, on the branches it crosses it for some distance. The branches at the apex of the stem are not attenuate, being immature.

LVII. PTILIDIUM Nees

Ptilidium Nees, Eur. Leb. I p. 95 (1833).
Blepharozia Dum., Rec. d'obs. p. 16 (1835).

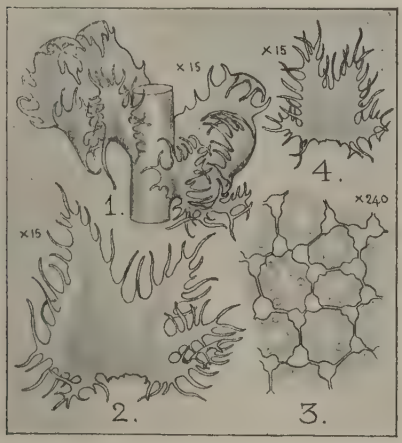
Plants generally densely tufted and brownish. *Stems pinnate or bipinnate*, or irregularly branched, with few and short rhizoids; branches lateral, *not attenuate nor flagelliferous at the apex.* Leaves incubous, *doubly bifid*, the antical portion larger, *the segments usually longly ciliate. Underleaves nearly resembling the leaves but only half as large.* ♀ inflorescence terminal on the stem or principal branch, appearing later through innovations on a somewhat short lateral branch which bears normal leaves at the base, and with bracts nearly resembling

the leaves at the apex. Perianth longly exserted, free, swollen and clavate, indistinctly plicate at the constricted mouth. Capsule ovoid. Elaters mostly bispiral. Androecia on the main stem or branches.

Tufts lax, purplish-red, stems pinnate; on moors.....*207. ciliare*
Tufts dense, yellowish-green or tawny, irregularly branched; leaves closer, more deeply divided and with longer cilia; on wood or on rocks
208. pulcherrimum

207. Ptilidium ciliare (L.) Hampe

Jungermannia ciliaris L., Sp. Pl. p. 1134 (1753).
Ptilidium ciliare Hampe, Prod. Fl. Herc. p. 76 (1836).
Blepharozia ciliaris Dum., Rec. d'obs. p. 16 (1835).



1. Stem. 2. Leaf. 3. Cells. 4. Underleaf.

Dioicous. In compact *reddish-brown* tufts or loosely scattered among mosses. Stems 2–6 cm long, *erect* or procumbent, *shortly pinnate and frequently bipinnate*, the branches *obtuse* especially near the apex of stem, *without flagella*; rhizoids scarce. Leaves approximate below, imbricate above and on the branches, almost transversely inserted, semi-amplexicaul, *concave*, roundish-subquadrate, *appearing quadrilobed and loosely ciliate*, being unequally bilobed to the middle, with the antical portion larger *patent or erecto-patent* and divided to *near the middle* into two unequal triangular-lanceolate segments, the margins with a few long rigid cilia, or the antical margin entire but frequently with long curved cilia at the base; the postical portion smaller, *suberect and partly lying on the stem*, *deeply* divided into two lanceolate segments with many long curved or straight cilia; cells 28–36 μ, roundish and oblong, the trigones very large, the cell cavity somewhat stellate; cuticle smooth. *Underleaves about half as large as the leaves*, appressed, rotund-quadrate, irregularly 2–4-lobed, the margins *longly ciliate*, the cilia frequently furcate. ♀ inflorescence terminal on the stem or main branches, being *later on short lateral branches* through innovations.

Involucral bracts embracing the perianth, concave, rotund-ovate, $\frac{1}{4}$–$\frac{1}{3}$ divided into 2–4 lobes, the margins densely and longly ciliate. Perianth large, longly exserted, swollen, pyriform, obtusely plicate above, the mouth contracted and 4–5-lobed and ciliate. Capsule subglobose, dark brown, inner layer of wall with semi-annular thickenings. Spores 27–33 μ, brown, finely papillose. Elaters 6–7 μ broad, mostly bispiral, reddish-brown. ♂ *plant much smaller*, in the same or separate tufts, procumbent, irregularly bipinnate. Androecium at the end of the principal branches, seldom intercalary, bracts in several pairs, smaller than the leaves, transverse, closely imbricate, complicate-concave, ventricose, unequally 3–4-lobed, with incurved cilia. Antheridia 1–2, large, without paraphyses.

var. **inundatum** Schiffn., Lotos No. 7 p. 347 (1900).

Wholly or partly submerged in marshes. *Dark olive green to dark brown, and tinged with violet.* In compact, erect tufts; stems brown, most commonly simply pinnate, the branches *longer* than in the typical plant, slender, suberect and frequently recurved towards the end, leaves more distant, *cilia fewer and shorter, cell-walls thin, trigones minute.*

Hab. On wet moors, more rarely on rather dry grassy banks and in exposed ground, mostly confined to subalpine and alpine regions. Var. *inundatum*, more or less submerged in marshes.

Distrib. N. to Shetland, widely distributed but only locally frequent, ascending to 4300 ft. alt.

This cannot be confused except with the following or with *Mastigophora Woodsii*, as the reddish-brown colour of the longly ciliate leaves is unlike other species. It most commonly forms loose erect tufts, or scattered stems, among mosses or heather, less frequently it is in compact tufts in wet ground.

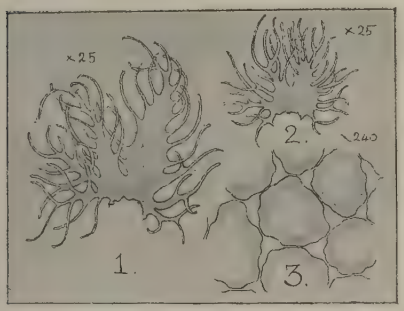
The cilia at the antical base of leaf are frequently broader at the lower end; on the postical margin they are usually 1-seriate throughout, and less rigid. Perianths are always absent on scattered stems, but are rather frequent when the tufts are compact; fruit is rare in Britain. The ♂ plant is very small and is easily overlooked.

The typical plant is large, reddish to reddish-brown, mostly bipinnate, with the leaves closely imbricated and rather densely ciliate. When growing as more or less scattered, erect stems among mosses in dry ground, it is of a similar colour but with the stems simply pinnate to slightly bipinnate, the leaves more distant, less incurved and with fewer cilia, this being the var. *ericetorum* Nees, *Eur. Leb.* III p. 119. Near the summits of our hills the leaves are still more distant and more spreading, the lobes rather narrower and less ciliate, with the terminal cilium generally conspicuous.

The var. *inundatum* is the extreme wet ground form and is sometimes quite submerged; between this and the typical plant is the var. *uliginosum* Schiffn. in Bauer's *Bryotheca Bohemica* no. 298, which more resembles the type in colour, being pale yellow to pale yellowish-brown and with the cell-walls thicker and the trigones larger than in the var. *inundatum*; this form is more frequent than the other in Britain. There is an earlier var. *uliginosum* of this species in Mougeot's *Stirp.* no. 1043, of which I have not seen a specimen.

208. Ptilidium pulcherrimum (Web.) Hampe

Jungermannia pulcherrima Web., Spicil. Fl. Götting. p. 150 (1778).
Ptilidium pulcherrimum Hampe, Prod. Fl. Herc. p. 76 (1836).
Ptilidium ciliare β *Wallrothianum* Nees, Eur. Leb. III p. 120 (1838).
Blepharozia pulcherrima Lindb., Musc. Scand. p. 5 (1879).
Ptilidium ciliare var. *pulcherrimum* Warnstf., Krypt. Fl. Mark Brand. p. 260 (1902).



1. Leaf. 2. Underleaf. 3. Cells.

Resembles *P. ciliare*, but differs in being smaller, *the patches very dense* and more decumbent, *yellowish-green or tawny*, seldom reddish-brown, the stems *prostrate* with ascending apex, intricate at base, irregularly and *much branched*, the branches short and rounded at the end, leaves densely imbricate, more erect and *embracing the stem*, more deeply divided, the segments *narrower and with more numerous, longer, and more incurved cilia*, involucral bracts narrower, perianth less swollen, androecium usually terminal on the main stem.

Hab. On the stems of trees or about their roots, less frequently on rocks in subalpine districts.

Distrib. Derby to Aberdeen, rare. Fr. July–Aug.

Variously given by authors as a variety of the preceding or as a distinct species. It can generally be separated from *P. ciliare* without difficulty, but not always so. The habit is different, the present plant being prostrate, never forming deep tufts; it is also confined to trees and rocks, while the other is nearly always on soil; the colour is commonly yellowish-green; the cilia are longer and give a velvety appearance to the plant, those at the base of the antical segment are as long as or longer than the breadth of that segment at the base while in *P. ciliare* they are shorter, they are more frequently furcate in *P. pulcherrimum*, especially on the upper leaves; the trigones are generally smaller in the latter, this being most noticeable towards the apex of the stem where the leaves are less mature.

Stephani states in *Spec. Hep.* vol 4 p. 43 that the principal difference between the two species is the much smaller leaf-cells of *P. pulcherrimum*; I cannot find this difference.

A small pale green form, with the stems seldom exceeding 1 cm in length, is sometimes found on wet sandstone rocks in shady ravines.

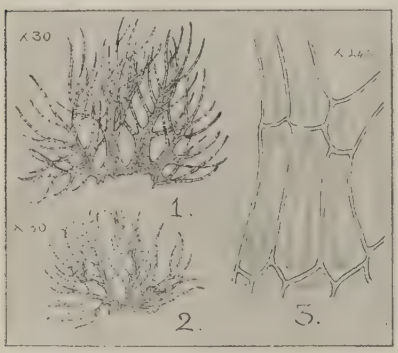
LVIII. TRICHOCOLEA Dum.

Thricholea Dum., Comm. Bot. p. 113 (1822); nom. emend. Nees, Eur. Leb. III p. 103 (1838).

Dioicous. Plants large, *whitish-green*. Stems pinnate or *multi-pinnately branched*. Leaves succubous, palmately lobed *almost to the base, the lobes divided into numerous single or branched capillary segments. Underleaves nearly resembling the leaves but much smaller*. ♀ inflorescence terminal on the stem or less frequently on a lengthened lateral branch, becoming axillary or lateral through innovations, surrounded by capillary involucral leaves. *Perianth absent. Calyptra erect, clavate, fleshy*, being a prolongation of the stem tissue surrounding the embryo, *covered by paraphyllia*, and with the sterile archegonia at its apex. Capsule oblong, the wall of several layers of cells. Androecia terminal on the main branches, bracts resembling the leaves.

209. Trichocolea tomentella (Ehrh.) Dum.

Jungermannia tomentella Ehrh., Beitr. 2 p. 150 (1785).
Thricholea tomentella Dum., Comm. Bot. p. 113 (1822); Syll. Jung. p. 67 (1831); nom. emend. Nees, Eur. Leb. III p. 103 (1838).



1. Leaf. 2. Underleaf. 3. Cells.

Dioicous. In *large pale green or cream-coloured patches* frequently of one to two feet in diameter. Stems *5–12* cm or longer, yellowish-green, brownish below, flexuous, suberect or procumbent, *2–3-pinnate*, the branches lateral, patent or erecto-patent, the apex of stem and of the principal branches thickened, paraphyllia composed of simple or branched cell-threads more or less numerous on the front and side of stem; rhizoids absent except a few at base of stem. Leaves distant or approximate on the stem, imbricate on the branches, patent, almost transversely inserted, *semi-amplexicaul*, divided *nearly to the base into two unequal lobes, each divided into narrow lobes with numerous capillary segments;* cells *hyaline*, at base of leaf rectangular and thin-walled narrowly cylindrical on the segments and appearing as if jointed;

cuticle striate-punctate. Underleaves hardly as broad as the stem, about half the size of the leaves, subquadrate, *quadrifid*, the laciniae with several single or branched *capillary segments* ♀ inflorescence terminal on the stem or principal branches, but *becoming axillary* or lateral through innovations. Calyptra *cylindrical-clavate*, fleshy, *covered with capillary, branched, coarsely striate-punctate paraphyllia.* Capsule oblong, purplish-brown, the wall of several layers of cells, pedicel long. Spores 10–15 μ, reddish-brown, smooth. Elaters bispiral. ♂ bracts on the end of the principal branches, resembling the leaves but with more connivent lobes. Antheridia large, globose, generally in pairs.

HAB. On wet banks in sheltered ground and in marshes.

DISTRIB. N. to Caithness, frequent; but rare in the drier districts; Ireland.

This large species is easily recognised, the numerous capillary segments of the leaves and underleaves being distinctive. It generally forms large patches of a foot or more in diameter, unmixed with other species, and is conspicuous by its pale green or cream colour, as well as by its size. It is found always in very wet ground, either on shady wet rocks or in marshy places.

The leaves are somewhat conduplicate and require care in dissecting off the stem. The stems are noticeably geniculate on the ultimate branches. The paraphyllia on the stem are branched cell-threads which, with the capillary segments of the leaves and underleaves, assist in retaining water.

The archegonia, which are numerous, are seated naked on the apex of the stem and are surrounded by the involucral bracts. When one of the archegonia is fertilized it penetrates the stem tissue, and the outer layers of the stem make an upward growth enclosing the sporogonium in a cylindrical sac. If the term calyptra be limited to an increase in growth of the archegonial venter, it is absent in *Trichocolea*.

Fruit is very rare in this species.

SUBFAMILY **Scapanioideae**

Stems arising from a creeping rhizome; branches few, lateral, seldom one or more sub-floral innovations which are postical. Leaves alternate, transverse, *complicate-bilobed, the antical lobe smaller than the postical*, margins *usually dentate or ciliate*, keel nearly always present, frequently winged. Underleaves absent, or in a few instances present and not resembling the leaves. ♀ inflorescence acrogynous. Perianth, when present, free, frontally compressed, or sub-inflated and 4-pluriplicate. Capsule 4-valved to the base. Elaters bispiral.

LIX. DIPLOPHYLLUM Dum.

Jungermannia Sect. *Diplophyllum* Dum., Syll. Jung. p. 44 (1831).
Diplophyllum Dum., Rec. d'obs. p. 15 (1835).
Jungermannia 1. *Diplophylleia* Reichenb., Nomenclat. p. 23 (1841).
Diplophylleia Trevisan, Mem. Ist. Lomb. Sc. Mat. e Nat. 4 (1877).

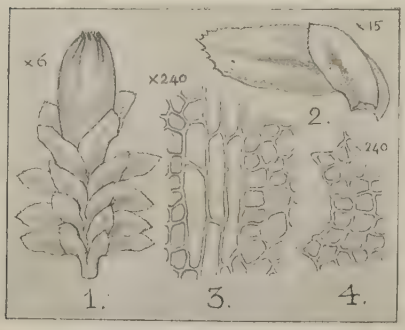
Stems arising from a creeping rhizome; branches few, lateral. Leaves *complicate-bilobed and keeled, typically cultriform or subfalcate*, the *antical lobe smaller than the postical* and partly lying on it. Underleaves absent. Involucral bracts nearly similar to the leaves. Perianth terminal, *more or less ovate, terete, 5-pluriplicate towards the contracted and denticulate mouth.* Capsule longly pedicellate, the walls of two layers of cells, the inner with semi-annular thickenings. Elaters bispiral. Gemmae frequent.

1 { Leaves with a band of elongated cells in the centre; cuticle nearly smooth ..... *210. albicans*
  { Leaves without such band; cuticle strongly verrucose 2

2 { Paroicous or monoicous; low ground plant ..... *212. obtusifolium*
  { Dioicous; alpine ..... *211. taxifolium*

210. Diplophyllum albicans (L.) Dum.

Jungermannia albicans L., Sp. Pl. p. 1133 (1753).
Diplophyllum albicans Dum., Rec. d'obs. p. 16 (1835).



1. Fertile plant. 2. Leaf. 3. Central cells. 4. Marginal do.

Dioicous. In compact or loose tufts or among mosses, variable in colour, pale yellowish-green to dark green, frequently brownish, or green with the upper part reddish-brown. Stems 1–5 cm long, stout, usually reddish-brown or yellowish-brown, erect or ascending, more or less furcately branched, innovating from below the perianth; rhizoids colourless, rather scarce. Leaves approximate or imbricate, *distichous*, transversely inserted,

semi-amplexicaul, $\frac{1}{3}$–$\frac{1}{2}$ *divided into two unequal conduplicate lobes*, the antical lobe $\frac{1}{2}$–$\frac{2}{3}$ the size of the postical lobe, *erecto-patent* or suberect, appressed partly to the stem and to the postical lobe, *narrowly oblong-ovate*, *subacute* or apiculate, sometimes obtuse, the whole or only the apex *denticulate*; postical lobe *patent to horizontal*, frequently arcuate, *oblong to ovate-lanceolate*, *subacute* or obtuse, *denticulate* throughout, especially the postical margin, or only at the apex; cells 12–15 μ, rounded-polygonal or subquadrate, the walls considerably and equally thickened, and through the middle of leaf a band four or more cells broad, of lengthened rectangular pellucid cells with thickened walls *forming a distinct stripe or vitta; cuticle nearly smooth.* Involucral bracts embracing the perianth in its lower half, resembling the leaves but more equally lobed, concave at base, the lobes frequently reflexed. Perianth oblong-obovate, obtusely plicate at the apex, the mouth contracted, shortly lobed and denticulate. Capsule oblong-ovate, reddish-brown, the inner layer of wall with numerous semi-annular thickenings. Spores 10–12 μ, yellowish-brown, finely punctate. Elaters reddish-brown, bispiral. Androecium terminal in a short spike or at the middle of the stem, bracts in 4–6 pairs, closely imbricate, ventricose at base, resembling the leaves, frequently reddish-brown. Antheridia generally 2, oblong-oval, very shortly pedicellate. Gemmae in yellowish-green clusters or scattered on the margins of the upper leaves, rotundate-stellate, showing 5–6 obtuse angles in profile, 1-celled.

HAB. On banks, rocks, trees, etc.

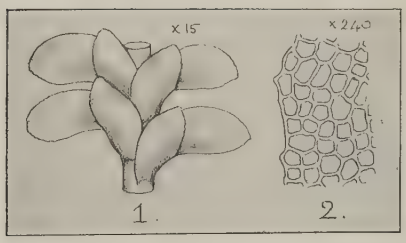
DISTRIB. N. to Shetland, ascending to the summit of the hills, very common; Ireland. Fr. April–June.

Our commonest hepatic in general, and very variable in habit, size and colour. It is fortunately nearly always easily recognized in the field by the white band running along the centre of both lobes; the only case in which it can give rise to doubt is with the small alpine form in which this band is not always readily seen with a lens. Sometimes this species is even taller than the measurements given, especially when occurring in shady ravines; occasionally the plant is almost white. When the leaves are dry, they are much curved forwards. Gemmae are common, and are formed on fertile as well as on sterile and on male plants.

The white band in the leaves appears to fulfil, to some extent, the function of a midrib. It consists of elongated, thickened cells which, as Tansley has shown, serve for conduction of water.

211. Diplophyllum taxifolium (Wahlenb.) Dum.

Jungermannia taxifolia Wahlenb., Fl. Lapp. p. 389 (1812).
Jungermannia albicans β *taxifolia* Nees, Eur. Leb. I p. 228 (1833).
Diplophyllum taxifolium Dum., Rec. d'obs. p. 16 (1835).



1. Stem with leaves. 2. Cells.

Dioicous. Resembling small forms of *D. albicans*. In small depressed or ascending patches *in alpine places*. Stems 1–2·5 cm long, stout, usually slightly branched with flexuose ascending branches and innovating from below the perianth. Leaves as in *D. albicans* but somewhat clavate when detached from the stem, the lobes smaller, *broader and more obtuse* and only crenulate-denticulate; the postical lobe frequently *oblong-obovate*, the antical lobe rather less denticulate; cells at base of middle of leaf lengthened, but not extending into the antical lobe and only occasionally for a short distance into the postical lobe, *never forming a distinct vitta* in the lobes; *cuticle strongly verruculose*. Perianth oval-oblong with the mouth very shortly lobed and crenulate-denticulate. ♂ bracts in 6–8 or more pairs, strongly ventricose at base. Antheridia generally 2, one frequently abortive. Gemmae at the apex of the upper leaves, colourless, rotundate-stellate, showing 5–6 obtuse angles in profile.

Hab. On moist rock ledges and on bare soil in the alpine region.

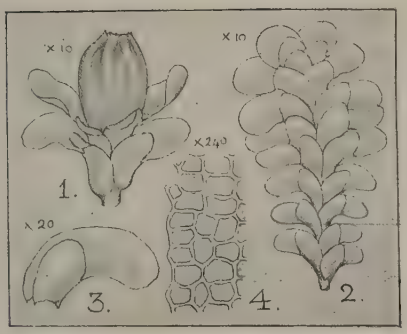
Distrib. Wales and Highlands of Scotland from 1700–3700 ft. alt., rare.

This keeps quite distinct from *D. albicans* in Britain, and Kaalaas states that it also does so in Norway, but it is frequently given as only a variety of that species by more southern Continental botanists. There is no difficulty in separating them in this country. The present plant occurs in similar places to the other, though confined to the alpine region, but it is always small and usually in depressed patches. The lobes are broader and the postical lobe is generally to some extent broadest above the middle. The absence of the median white band in the lobe is usually sufficient to identify it in the field. The elongated cells do not extend into the antical lobe and generally not into the postical, though they sometimes do into the latter for a short distance, but not as a well defined band. The apices of the lobes have as a rule shorter teeth than in *D. albicans* and are only crenulate-denticulate, while in *D. albicans*, especially in the postical lobe, they are serrulate-denticulate; the cuticle is also coarsely verruculose in the latter species, but this does not apply to the elongated cells, these being smooth in both plants.

♂ and ♀ plants sometimes grow in the some patch, but fruit has not been noted in Britain. Gemmae are common but scarcer than in *D. albicans*, and are found on both sexes as in that species.

212. Diplophyllum obtusifolium (Hook.) Dum.

Jungermannia obtusifolia Hook., Brit. Jung. *pl.* 26 (1812).
Diplophyllum obtusifolium Dum., Rec. d'obs. p. 16 (1835).
Diplophylleia obtusifolia Trevis., Mem. Ist. Lomb. 4 p. 420 (1877).



1. Fertile plant. 2. Sterile stem.
3. Leaf. 4. Cells.

Paroicous and occasionally monoicous. In *small* loose or compact patches or scattered among other species, pale green or yellowish-green, sometimes purplish-brown. Stems *5–12 mm* long, green to purplish-brown, flexuous or arcuate, *prostrate* with the apex ascending, or suberect when among mosses, simple or branched, sometimes innovating from below the perianth; rhizoids long, colourless, *numerous to apex of stem*. Leaves approximate below, *accrescent and closely imbricate above*, transversely inserted, semi-amplexicaul, ½ divided into two unequal conduplicate lobes, the antical lobe ⅔ the size of the postical lobe, suberect and appressed, oblong-oval, rounded at the apex or apiculate, minutely crenulate-denticulate or less frequently entire; postical lobe nearly horizontal, slightly *concave, oblong-obovate and arcuate, broadly rounded at the apex*, seldom apiculate, denticulate or entire; cells 14–16 μ, rounded-polygonal or subquadrate, walls considerably and equally thickened, cells at middle of leaf lengthened but not extending into the lobe, *not forming a distinct vitta;* cuticle *strongly verruculose*. Involucral bracts embracing the perianth at its base, resembling the leaves but larger and not keeled, ventricose at base. Perianth large, oblong-obovate, 4–6-plicate above, the mouth contracted, shortly lobed, dentate and setulose. Capsule oval, inner wall *with very few complete* semi-annular thickenings. Spores *7–9* μ, yellowish-brown, thickly verruculose. Elaters reddish-brown, bispiral. ♂ *bracts immediately below the perianth* or occasionally on a separate branch, in 3–5 pairs, ventricose at base. Antheridia 2–3.

HAB. On loamy banks, frequently with *D. albicans*.

DISTRIB. Wales to Shetland, rare; Ireland. Fr. Spring.

The paroicous inflorescence, which is nearly always present, will at once separate this species from the others; occasionally ♂ inflorescence occurs also at the apex of a branch on the same plant. The crowded bracts give the apex of the stem a rounded appearance which is characteristic. It is a smaller plant than *D. albicans*, and the lobes are without the median band of cells; the elongated cells which are found at the base of the leaf are filled with chlorophyll granules and do not have the pellucid appearance seen in the other species; the lobes are relatively broader, and although the antical lobe is occasionally apiculate or even subacute, both are in general much more obtuse than in the others; they are

sometimes entire, though commonly crenulate or denticulate; the cuticle is coarsely verruculose, while it is usually nearly smooth in *D. albicans*. The postical lobe is broadest at or above the middle, and the base of the postical margin has some spinous-teeth which are frequently recurved.

This species is confined to the low ground, its distribution being the reverse of that of *D. taxifolium*. It very frequently grows with *D. albicans* and is probably sometimes overlooked on this account, but they can be easily distinguished in the field. Fruit is common, but gemmae are much scarcer than in the others.

LX. SCAPANIA Dum.

Martinellia Sect. a. *p.p.* S. F. Gray, Nat. Arr. Brit. Pl. 1 p. 691 (1821); Lindb., Hep. in Hib. lect. p. 518 (1875).
Radula Dum., Comm. Bot. p. 112 (1823).
Radula Sect. *Scapania* Dum., Syll. Jung. p. 38 (1831).
Scapania Dum., Rec. d'obs. p. 14 (1835).

Generally dioicous. Plants mostly large. Stems arising from a creeping rhizome; branches few, lateral. *Leaves complicate-bilobed*, nearly always *keeled*, frequently winged, *the antical lobe smaller than the postical*, rarely the lobes almost equal. Underleaves absent. Involucral bracts resembling the leaves but slightly larger and more equally lobed. Perianth terminal, almost always *frontally compressed*, rarely subplicate, inflated below, *the mouth wide*, *truncate*, *usually dentate*, decurved when young. Capsule oval to globose, longly exserted, the inner layer of wall with semi-annular thickenings. Androecia spicate, rarely hypogynous, bracts nearly equally bilobed and generally with entire margins; antheridia mixed with variously formed paraphyses. Gemmae frequent.

This genus, mostly confined to the Northern Hemisphere, is well represented in the British Isles, especially in the wetter mountainous districts. Many of the species are very variable and frequently give rise to much difficulty in determining them. No one would propose, for instance, to combine such well marked plants as *S. subalpina* and *S. irrigua* as one species, yet it is sometimes difficult to define the limits of each; still more difficult is it sometimes to separate *S. subalpina* from *S. undulata* or *S. dentata*, while the latter two have several intermediate forms. The student must not, however, at once consider any specimen which seems to combine the characters of two species as being an intermediate form. Such forms are, in general, uncommon in Britain, and the greater the experience which the student has, the less frequently will he have difficulty in referring the specimen definitely to one species.

The most important character is the shape of the leaf-lobes; these must be dissected off the stem to allow their form to be accurately recognised, and they must be mature leaves. Young plants of some of the species are much like each other and frequently cause confusion. A still more frequent cause is the mistaking male bracts for ordinary leaves, as the lobes of these bracts are mostly nearly equal in size and it may not be at once evident that it is the male plant which is under examination. In the mature state when the bracts are closely imbricate and probably ventricose at base, it is natural to expect antheridia, but

in the further course of development when the antheridia have disappeared and the bracts are not imbricated, careful examination may be necessary to prevent a mistake. Paraphyses can very frequently be detected in some of these old bracts and will give a sure character.

An easily observed and useful feature in some species is the structure of the commissure or junction of the lobes. It is a simple matter to make transverse sections of complicate leaves like those of *Scapania*, and the commissure can be readily seen. In *S. compacta* and *S. Bartlingii* this is not keeled, that is, it is composed of only a single layer of cells as elsewhere throughout the leaf (see fig. of *S. compacta*); in our other species it is composed of more than one layer, sometimes of several layers (see fig. of *S. aequiloba*), and these may extend into an uniseriate layer forming a "wing" (see fig. of *S. nemorosa*). The amount of curvature of the commissure and the angle which it makes with the stem are also of service.

The cuticle of the leaf may vary greatly in the same species, but it is an important character in distinguishing some of them. The papillae, when present, can be generally most easily observed on the leaves towards the apex of the stem; they are often hardly noticeable on old leaves and they will not probably be seen at the commissure of any leaf. A lobe when folded back is sufficient to allow the papillosity to be seen; it is seldom necessary to make a section of the leaf though it may be sometimes advisable.

1 { Leaves divided to base; reddish alpine plants 2
  { Leaves not divided beyond ⅔ 3

2 { Postical lobe flat, cilia straight; cuticle nearly smooth *223. ornithopodioides*
  { Postical lobe recurved, cilia irregular, frequently curved; cuticle coarsely verrucose ..... *222. nimbosa*

3 { Cuticle distinctly verrucose 4
  { Cuticle smooth, or more or less roughened 5

4 { Antical lobe triangular-ovate to subrotund, incumbent; postical lobe strongly dentate ..... *219. aspera*
  { Antical lobe ovate-subquadrate, erecto-patent, or reflexed, apex acute, usually much more divergent from the stem; postical lobe slightly dentate, or almost entire ..... *216. aequiloba*

5 { Lobes equal or nearly so 6
  { Lobes unequal 8

6 { Prostrate, strongly creeping; antical lobe rather smaller, almost oblique, outer angle divergent, rather acute; leaves not keeled ..... *215. Bartlingii*
  { Ascending or erect; lobes rotundate; leaves with or without a keel 7

7 { Leaves ⅓ divided, entire, not keeled; antical lobe not crossing the stem *213. compacta*
  { Leaves ½ divided, more or less dentate, keeled; antical lobe crossing the stem *214. subalpina*

8 { Margin of leaves entire (occasionally with a few small teeth near apex of stem) 9
  { Margin of leaves ciliate, dentate or serrate 16

9 { Antical lobe reniform, very convex, 2–3 times smaller than postical lobe *227. uliginosa*
  { Antical lobe not reniform, usually about ½ size of postical lobe 10

10 { Plant small, stem ·5–2 cm long; on banks and on wet ledges 11
   { Plant large, stem more than 2 cm long; in marshes or on wet rocks (*S. calcicola* on banks) 12

11 { Stem firm, with few rhizoids except at base; yellowish-green; perianth sometimes dentate ..... *231. curta*
   { Stem slender, with copious rhizoids; leaves accrescent; perianth entire or nearly so ..... *232. rosacea*

12 { Postical lobe concave; on alpine banks ..... *217. calcicola*
Postical lobe convex; in marshes and on wet rocks 13

13 { Very flaccid; keel of leaves semi-circular 14
Little or not flaccid; keel of leaves usually weakly arched 15

14 { Yellow-green; antical lobe cordate-reniform; postical lobe rarely reflexed ..... *229. paludosa*
Dull, or brownish-green; antical lobe cordate-ovate; postical lobe usually reflexed ..... *228. obliqua*

15 { Antical lobe usually with a point; cell-walls thickened at the angles; stem with some rhizoids to apex; yellowish-green ..... *230. irrigua*
Antical lobe rounded; cell-walls not thickened at the angles; stem without rhizoids at apex; green to reddish ..... *226. undulata*

16 { Both lobes acute and serrate ..... *233. umbrosa*
Postical lobe, at least, obtuse 17

17 { Leaf-cells stellate; alpine ..... *220. crassiretis*
Leaf-cells not stellate 18

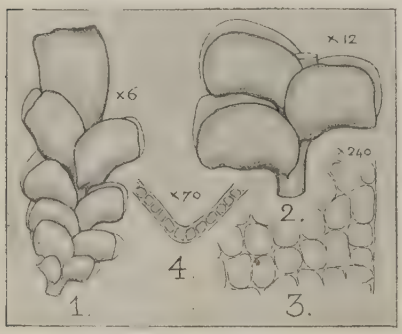
18 { Postical lobe ciliate ..... *221. nemorosa*
Postical lobe dentate 19

19 { Ochraceous or brown; antical lobe reniform-rotund, frequently reflexed, often with coarse teeth at its base ..... *218. gracilis*
Usually reddish; antical lobe subquadrate to round or ovate 20

20 { Small; leaves densely imbricated; antical lobe ovate ..... *225. intermedia*
Usually large; leaves less closely imbricated; antical lobe broader; on wetter ground ..... *224. dentata*

213. Scapania compacta (Roth.) Dum.

Jungermannia compacta Roth., Tent. Fl. Germ. p. 375 (1800).
Jungermannia resupinata Hook., Brit. Jung. *pl.* 23 (1812).
Scapania compacta Dum., Rec. d'obs. p. 14 (1835).



1. Fertile plant. 2. Stem with leaves.
3. Cells. 4. Section of leaf.

Polyoicous. In compact *reddish-brown or yellowish-brown*, seldom green, patches. Stems 1 – 2 cm long, rigid, prostrate with ascending apex, or *ascending*, simple, or occasionally slightly branched; rhizoids numerous to apex of stem. Leaves *rigid*, approximate below, imbricate above, semi-amplexicaul, *not crossing the stem*, not decurrent, horizontal, cordate-quadrate when flattened out, $\frac{1}{3}$ divided *into two equal* or nearly equal lobes, the antical lobe *slightly incurved* or sometimes reflexed, *rotundate-quadrate*, usually

entire; postical lobe generally parallel with the antical lobe, the margin slightly reflexed near the base, rotundate-ovate, entire or with a few distant, obtuse, 1-celled teeth; commissure straight, *not keeled*; cells 17–22 μ, *of nearly equal size throughout*, roundish-polygonal, trigones rather large; cuticle nearly smooth. Involucral bracts slightly larger than the leaves and more frequently denticulate. Perianth obovate to turbinate, the mouth truncate and *sinuate-entire* or slightly dentate. Capsule oval, reddish-brown, the inner wall with numerous incomplete and complete semi-annular thickenings. Spores 13–16 μ, reddish-brown, finely verruculose; elaters 6–7 μ broad, loosely bispiral. ♂ *bracts immediately below the perianth or at the apex of branches on the same or separate plants*, slightly ventricose; antheridia 2–4, oval, on a pedicel of about equal length, with several linear-lanceolate leaf-like paraphyses. Gemmae yellow-green, sometimes violet, globose to elliptical, most often 1-celled, sometimes 2-celled.

Hab. On rocky banks, rocks and old walls.

Distrib. N. to Shetland, frequent except towards the extreme north; Ireland. Fr. Mar.–July and in late Autumn.

This is one of the best marked species of the genus and always keeps quite distinct. It is most commonly paroicous in Britain, but is occasionally dioicous, as it apparently always is on the Continent; both forms of inflorescence may be seen in the same tuft, but are more frequently in separate tufts; it is also sometimes monoicous.

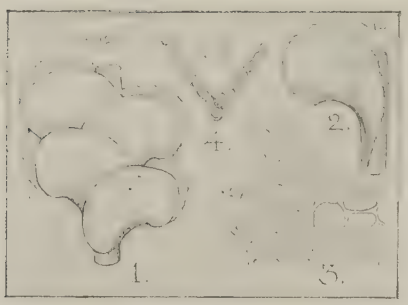
The usual locality for this species is rocky banks or rocks with some soil attached; in such places the leaves are rigid and opaque. It is occasionally found in detritus at the side of streams in similar places to *S. subalpina*, and in this case might be confused with that species, but the usually paroicous inflorescence will separate it, also the leaves are only $\frac{1}{3}$ bilobed and are not keeled, the lobes generally equal or nearly so, the antical lobe more reniform and not crossing the stem, the postical lobe not decurrent, the cells of nearly the same size throughout and the trigones usually larger; it must be remembered that the male bracts of *S. subalpina* are only $\frac{1}{3}$ bilobed.

The lobes near the apex of the stem are practically equal in size; further down the antical lobe is slightly smaller. There are sometimes a few distant obtuse teeth on the margin of the antical lobe of the upper leaves. Both lobes, especially the antical lobe, are frequently pointed, but hardly acute, at the apex; the point is usually only noticeable when the leaf is flattened out.

A south European plant, the var. *Biroliana* Massal., differs from the type in being smaller and in having the antical lobe only a third to a half as large as the postical lobe except in the uppermost leaves.

214. Scapania subalpina (Nees) Dum.

Jungermannia subalpina Nees in Lindenb., Syn. Hep. Eur. p. 55 (1829).
Scapania subalpina Dum., Rec. d'obs. p. 14 (1835).



1. Stem with leaves (antical view). 2. Leaf (postical). 3. Cells. 4. Section of leaf.

Dioicous. In pale green to reddish-brown compact tufts. Stems to 3 cm long or more, almost denudate and black below, reddish-brown to green above, erect, simple or very sparingly branched, with several innovations from below the perianth; rhizoids numerous below, scarce above and on the innovations. Leaves soft, approximate or imbricate, usually destroyed on lower part of stem, patent, $\frac{1}{2}$ *divided into two nearly equal lobes*, the antical lobe incumbent or sometimes reflexed, not decurrent, *rotundate*, occasionally subacute at the apex, the margin slightly denticulate near the apex or entire, frequently undulate especially near apex of stem, widely *crossing the stem;* postical lobe appressed to the stem with the margin *recurved at base*, rotund-ovate, *rather strongly decurrent*, *denticulate*, seldom quite entire, the teeth short, *acute*, 1-celled; commissure nearly straight, keeled; cells 18–24 μ, polygonal, much *smaller at the margin*, walls very variable, thin, with small or rather large trigones, or with thickened walls, *near margin usually with greatly and nearly equally thickened walls;* cuticle granulate. Involucral bracts slightly larger than the leaves. Perianth oblong, the mouth truncate, sinuate and *denticulate*, the teeth somewhat distant. Capsule oval, the inner wall with numerous nodular and incomplete, *seldom complete*, semi-annular thickenings. Spores 20 μ, reddish-brown, finely punctate; elaters 6 μ broad, bispiral. Androecium spicate at the apex of the stem and branches; bracts closely imbricate, ventricose, $\frac{1}{3}$ *bilobed*, the lobes equal; antheridia generally 2, mostly oval, on a pedicel about half as long; paraphyses small. Gemmae yellow-green, sometimes violet, oval, 2-celled.

var. **undulifolia** Nees in G. L. N., Syn. Hep. p. 65 (1844); Gott. and Rabh., Hep. Eur. Exs. No. 465 c. fig. (1869); Husn., Hep. Gall. p. 20 (1875).

Leaves undulate to *undulate-crispate* both in the wet and dried state, lobes entire or almost so except at the apex of the stem, cell-walls thin, trigones small, mouth of perianth subentire.

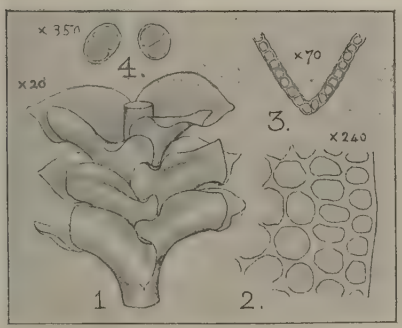
HAB. In wet gravelly detritus, especially by the side of streams.

DISTRIB. From Cornwall ? and Wales to Shetland in subalpine and alpine districts, ascending to 3300 ft. alt. in Perthshire, frequent in the Highlands, uncommon elsewhere ; Ireland. Fr. April–July. Var. *undulifolia*, Durham ; Scotland ; rare.

This species is nearly always found in gravelly detritus at the side of streams, especially in ravines and in places where moist detritus has accumulated on the hills, the stems being half buried in the detritus ; it very rarely occurs directly on rocks. It is, in general, recognised without difficulty by the rotundate lobes which are equal in size towards the apex of the stem and nearly so elsewhere, but forms occur in which the antical lobe is considerably smaller than the postical lobe, less rotundate or even somewhat acute ; these plants are with difficulty separated from some forms of *S. undulata* and *S. dentata*, and in fact the limits between the three are uncertain. These forms are, however, rare in Britain, and the student need seldom be in doubt as to the present plant ; it nearly always has the postical lobe of some of the leaves sharply denticulate and the cells near the margin of the leaf with thickened walls which will separate it from *S. undulata*, while in *S. dentata* the antical lobe is usually less rotundate and seldom crosses the stem, as it generally does to a considerable extent in the upper leaves of *S. subalpina* ; the half-buried stems of the present species assist in allowing it to be recognised in some cases. The three plants also differ in colour in their common forms. The rather strongly decurrent postical lobe will separate almost any form of this species from *S. irrigua*, which sometimes bears much resemblance to it.

215. Scapania Bartlingii (Hampe) Nees

Jungermannia Bartlingii Hampe in Nees, Eur. Leb. II p. 425 (1836).
Scapania Bartlingii Nees in G. L. N., Syn. Hep. p. 64 (1844).
Scapania Carestiae De Not., Mem. Accad. Tor. 22 p. 373 (1865).



1. Stem with leaves. 2. Cells. 3. Section of leaf. 4. Gemmae.

Dioicous. *Small.* In compact, *depressed whitish-green* or *pale yellowish-green patches.* Stems 6–14 mm long, reddish-brown to nearly black below, paler above, stout, flexuose, *prostrate* with ascending apex, simple or sparingly branched; rhizoids numerous except near apex of stem. Leaves imbricate, mostly destroyed below, *embracing* but not crossing the stem, not decurrent, nearly horizontal but slightly curving forwards, *divided to* $\frac{1}{4}$, seldom to $\frac{1}{3}$, into two *nearly equal lobes with entire and undulate* margins, the

antical lobe oval, obtuse, or with a point, *patulous and reflexed*; postical lobe slightly larger and broader, erect or slightly reflexed, both lobes frequently acute through being gemmiferous; commissure straight or slightly curved, *not keeled*; cells 14–21 μ, rounded, smaller and subquadrate at the margin, trigones rather large, the marginal cells with more strongly and nearly equally thickened walls; *cuticle smooth* or nearly so. Involucral bracts larger than the leaves. Perianth oblong-ovate, the mouth obliquely truncate, *entire*, slightly uneven. Androecium at the apex or middle of the stem, bracts in several pairs, imbricated, with the apex of the postical lobe spreading or reflexed, ventricose; antheridia 2–3, oval, on a pedicel of about equal length. Gemmae in *reddish-brown* clusters at the apex of the uppermost leaves, elliptical or oval, occasionally pyriform, 2-celled.

HAB. On rocky banks and on soil; calcicolous.

DISTRIB. Carmarthen and York to Forfar, rare. Fr. April–June.

The pale whitish-green colour, together with the reflexed antical lobe, which gives the plant a crisped appearance, the short prostrate stems, the nearly equally lobed, undulate and always entire leaves, distinguish this species. It can only be confused with small forms of *S. aequiloba*, which is likewise a calcicolous species; the latter can be known by its coarsely verrucose cuticle, its more distichous leaves which are keeled, the lobes less equal and the postical lobe generally dentate.

S. compacta differs at sight by its colour, and by the antical lobe not undulate and seldom reflexed. *S. subalpina* has taller and erect stems, rotundate and keeled leaves, the antical lobe crossing the stem in the upper leaves at least, the lobes frequently denticulate and the mouth of perianth denticulate.

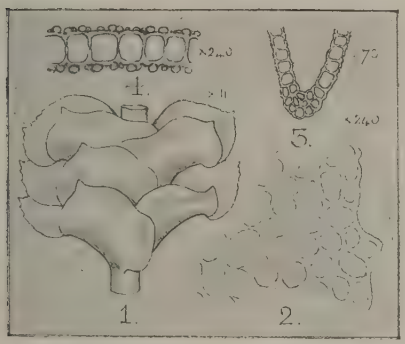
Gemmae are common in this species and the cells towards the apex of the gemmiferous leaves are lengthened. The capsule appears to be unknown.

216. Scapania aequiloba (Schwaegr). Dum.

Jungermannia aequiloba Schwaegr., Prod. Musc. Hep. p. 214 (1814).
Scapania aequiloba Dum., Rec. d'obs. p. 14 (1835); G.L.N., Syn. Hep. p. 64 (1844); C. Massal., Spec. Ital. Gen. Scap. in Malpighia 16 p. 12 reprint (1903); Pears., Hep. Brit. Isles p. 212 (1900); K. Müll., Monog. Scap. p. 225 (1905).
Jungermannia tyrolensis Nees, Eur. Leb. II p. 440 (1836).

Dioicous. In yellow-green to brownish compact tufts, or more commonly scattered among mosses. Stems 2–4 cm long, nearly black below, brownish-yellow above, flexuous, ascending or erect, usually simple; rhizoids long, scarce on stems when erect. Leaves very regularly and *nearly horizontally* inserted, very slightly decurrent, $\frac{1}{2}$ or less divided into two unequal, in the *upper leaves subequal*, lobes, the antical lobe oblique, slightly crossing the stem, *ovate-subquadrate*, *apiculate* or sometimes obtuse, the apex distant from

the stem, erecto-patent or *reflexed*, *the margin entire* or less frequently sparingly dentate; postical lobe about *a third* larger, subovate or oval, *apiculate*, the margin *dentate towards the apex* or entire, *slightly reflexed;* commissure straight or slightly curved; cells 15–20 μ, roundish, walls considerably thickened, especially at the angles, the marginal cells smaller, subquadrate and with greatly and nearly equally thickened walls; *cuticle coarsely verrucose.* Involucral bracts slightly larger than the leaves. Perianth oblong-obovate, curved, the mouth shortly laciniate and dentate-ciliate. Capsule oval, brown. Spores 10 μ, yellowish-brown, smooth; elaters 6 μ broad, bispiral. Androecium at the apex of the stem, bracts in 3–6 pairs, suberect, nearly equally lobed, ventricose at base; antheridia oval, generally in pairs, paraphyses lanceolate or linear. Gemmae in clusters on the apex of the uppermost leaves, greenish-white, elliptical to ovoid, 2-celled.



1. Stem with leaves. 2. Cells. 3. Section of leaf. 4. Do., more magnified.

Hab. On rock ledges, on soil among rocks and in sand dunes; calcicolous.

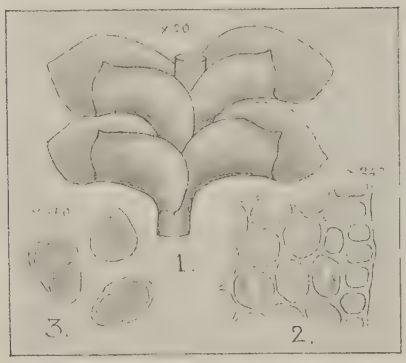
Distrib. Derby to Ross, ascending to 3200 ft. alt. in Perthshire; rare. Ireland.

Typical plants of this species and of *S. aspera* are well defined from each other, but forms occur which give much difficulty and some which might perhaps as well be placed to one as to the other. The present species is more slender, leaves more distichous and with more equal lobes; the antical lobe only sometimes crosses the stem while it nearly always does so and to a greater extent in *S. aspera*, and it is usually reflexed, in place of being convex and lying on the stem as in the latter, it is also narrower, more pointed and less dentate; the postical lobe is narrower in its upper half and pointed, much less reflexed and with shorter teeth. ♂ plants are common and are frequently found in the same tuft as the ♀, and the antheridia are only 1–2 in each bract, while in *S. aspera* the ♂ plant is rare, or at least uncommon, occurs in separate tufts, and several antheridia are found in each bract. *S. aequiloba* occurs most frequently as more or less scattered stems among mosses; *S. aspera* is more generally found in unmixed tufts. Both are calcicolous species, and with others of that class, are sometimes found among the shell-sand of dunes.

A Continental species, to be looked for in Britain, is *S. verrucosa* Heeg. It has considerable resemblance to *S. aequiloba* and *S. aspera*, and like them has a coarsely verrucose cuticle, but it can at once be distinguished by the gemmae, which are angular.

217. Scapania calcicola (Arn. et Perss.) Ingham

Martinellia calcicola Arnell et Persson, Rev. Bryol. p. 97 (1903).
Scapania calcicola Ingham, The Naturalist p. 11 (1904); K. Müll., Monog. Scap. p. 235 (1905).



1. Stem with leaves. 2. Cells. 3. Gemmae.

Dioicous. In loose tufts or scattered among mosses, dark brown to yellowish-green, resembling in habit *S. aequiloba*. Stems 2–3 cm long, rigid, simple or less frequently with 1–2 branches, ascending to erect, equally leaved; rhizoids colourless, long and numerous below, usually scarce above. Leaves approximate to slightly imbricate, very regularly and nearly horizontally inserted, not decurrent, ½ or less divided into two unequal lobes, the antical lobe *rhomboid*, frequently apiculate, *not crossing the stem*, *patent*, with the apex somewhat incurved, *entire* or very slightly dentate near the apex; postical lobe *twice as large*, plane or *concave*, *not reflexed*, oval, *rounded* at the apex or shortly acuminate, rarely apiculate, the margin *entire*, rarely slightly denticulate towards the apex; commissure straight or slightly curved; cells 16–20 μ, roundish-quadrate, walls slightly thickened, more so at the angles, the trigones being rather small but distinct; marginal cells smaller, subquadrate, the walls considerably thickened; cuticle papillose or *almost smooth*. Perianth unknown. Androecium at the apex of the stem, bracts resembling the leaves; antheridia in pairs. Gemmae in clusters on the apex of the uppermost leaves, yellowish-green to pale yellowish-brown, oval to globose-oval, occasionally pyriform or slightly angular, 2-celled, seldom 1-celled.

Hab. On alpine banks and rocks.

Distrib. Creag-an-Lochain-Lairige, Killin, 1800 ft. alt., 1900 *(S. M. Macvicar)*.

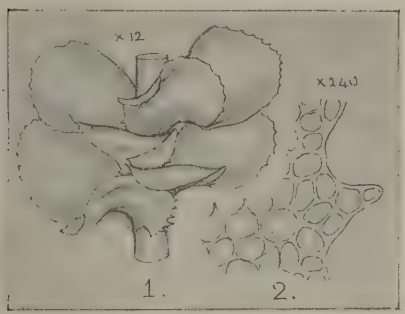
This species resembles *S. aequiloba* in habit, but differs from it by the antical lobe not crossing the stem and being smaller, the postical lobe flat or concave and nearly always entire; the cuticle smooth or nearly so and the gemmae highly coloured. The leaves of the male plant of *S. aequiloba* frequently do not cross the stem, but the other characters of the species will separate it.

The concave postical lobe is characteristic, as this feature is seen in only two other of our species, *S. curta* and *S. rosacea*, which are much smaller than the present plant. *S. calcicola* might possibly be mistaken in the field for *Sphenolobus saxicolus* on this account, especially as the leaf-margins of the *Scapania* appear practically entire under a pocket lens.

S. calcicola has been recorded from England and Ireland, but this was owing to a mistaken identification. The Perthshire specimen is typical and the name has been confirmed by Arnell, one of the authors of the species.

218. Scapania gracilis (Lindb.) Kaal.

Jungermannia nemorosa γ *recurvifolia* Hook., Brit. Jung. no. 21 (1812).
Scapania resupinata Dum., Rec. d'obs. p. 14 *p.p.* (1835); Carr., Brit. Hep. p. 77 (1874); Pears., Hep. Brit. Isles, p. 217 (1900).
Martinellia gracilis Lindb., Not. Soc. F. Fl. Fenn. 13 p. 365 (1874).
Scapania gracilis Kaal., De Dist. Hep. Norveg. p. 243 (1893).



1. Stem with leaves. 2. Cells.

Dioicous. In compact *yellow-brown* or olive-brown patches. Stems commonly 3–6 cm long, but varying from 2–12 cm, black, rigid, flexuous, erect, simple or sparingly branched, frequently repeatedly innovant from below the ♀ inflorescence; rhizoids numerous except near apex of stem. Leaves approximate below, imbricate above, patent, embracing the stem, decurrent, ⅔ *divided* into two unequal lobes, the antical lobe widely crossing the stem, *obliquely rotundreniform*, with the apex rounded, seldom pointed, convex, or more *frequently reflexed*, slightly dentate, the teeth broad at base, acute, *frequently spinous-ciliate or coarsely dentate at the antical base*, especially when approaching the perianth; postical lobe about a half larger, oblong-obovate, obtuse, *distantly serrate-dentate*, broadly reflexed; commissure short, slightly curved, keeled; cells 16–22 μ, rounded-oblong, walls thickened, trigones rather large, the marginal cells smaller and strongly and nearly equally thickened; *cuticle smooth* or finely granulate. Involucral bracts slightly larger than the leaves, the antical lobe usually spinous-ciliate or spinous-dentate at the base. Perianth oblong-obovate, the mouth shortly lobed and spinous-dentate or ciliate-dentate. Capsule oval, yellow-brown, inner wall with numerous semi-annular thickenings. Spores 13–15 μ,

reddish-brown, thickly granulate-punctate; elaters 7 μ broad, pale reddish-brown. Androecium at the apex of the stem and branches, bracts in 4–5 pairs, imbricate, antical lobes ventricose at base, dentate to ciliate at the base, both lobes dentate at the apex. Antheridia 2–3, oval on a pedicel of equal length, with several linear paraphyses. Gemmae in clusters or scattered on the apex of the upper leaves, greenish-white, oval to ovoid, 1–2-celled.

var. **laxifolia** Carr., Brit. Hep. p. 77 (1876).

Scapania laxifolia Lett, List. Hep. Brit. Isles p. 65 (1902).

Tall, in very loose brown tufts or *scattered among mosses in hilly districts*. Leaves approximate but *appearing as if distant* on account of *both lobes being strongly reflexed*, the antical lobe frequently apiculate or bluntly pointed, the cilia at base often well marked; postical lobe narrower and longer in proportion to the antical lobe than in the type.

var. **integrifolia** Lindb., Hep. in Hib. lect. p. 521 (1875).

Smaller, leaves imbricate, the margin *entire* or nearly so, antical lobe frequently *incumbent*.

var. **minor** Pears., Hep. Brit. Isles p. 217 (1900).

In *densely matted patches*, usually on rather dry rocks and boulders. Stems 1·2–2·5 cm long, leaves *closely imbricate*, dentate, the antical lobe *strongly reflexed*.

Hab. Among rocks, boulders and rocky banks. Var. *laxifolia* on the hills.

Distrib. N. to Shetland, common in subalpine districts in the west, rare in the east; Ireland. Fr. April–June and late Autumn.

This species in its typical form, which is common on the western side of the British Isles, is a large and rather coarse plant occurring in usually extensive brownish patches or tufts, such tufts being larger than in any other of our species of the genus; the frequently reflexed rotund-reniform antical lobe attracts attention in the field. It can generally be known when typical from any of our species by the cilia or teeth at the base of the antical lobe; these are nearly always present on some of the leaves near the perianth and for some distance below it, and as perianths are common, it is a usually available character; in depauperate or small forms the cilia are commonly absent. Although this species is most abundant on siliceous rocks, it is also found on limestone. It is closely related to *S. aspera*, and is sometimes difficult to separate from that plant, especially in calcareous districts; in fact, Massalongo and Müller have doubts of it being always distinct on the Continent. Well developed specimens of the two species bear little resemblance to one another, and we have not in Britain any form which could be considered as intermediate. The present

species can generally be known by its antical lobe frequently reflexed, broader, and more widely crossing the stem, as well as by the cilia or teeth at the base, the postical lobe more obovate, the shorter commissure and the smooth or only slightly rough cuticle ; the patches are also usually more compact.

The plant is green in the early part of the year, *i.e.* after the new growth appears, and it might then be mistaken in the field for *S. nemorosa*, but it grows generally in more compact tufts than does that species, and the leaves are not ciliate. Young plants might be mistaken for *S. curta* or occasionally even *S. umbrosa*.

The ♂ and ♀ are frequently present in the same tuft, and fruit is rather common.

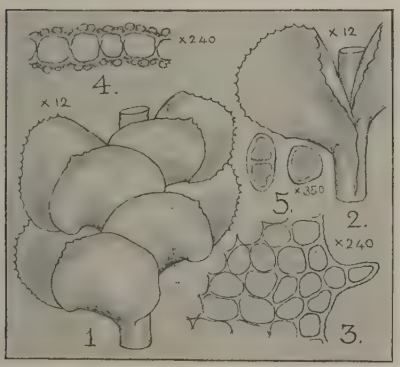
Var. *laxifolia* is a tall plant with firm stems which grow erect and usually scattered among mosses in rocky places on the hills. Var. *integrifolia* varies in size but is most commonly small. Var. *minor* occurs usually on rather dry rocks and on boulders, forming compact tufts ; it may grow to a considerable size and sometimes can be seen gradually to approach the typical plant until it becomes undistinguishable from it.

S. Bolanderi Aust., from the Pacific coast of *N. America*, is closely related to this species, as Müller remarks. Both have the cilia at the base of the antical lobe, but the American plant has this lobe incumbent, broadly ovate, narrower and more acute at the apex, and the postical lobe longer in proportion and more obovate ; the margin of both lobes is also more serrate-dentate.

√ 219. Scapania aspera Bernet

Scapania aequiloba forma *dentata major* Gottsche in Gott. and Rabh., Hep. Eur. Exs.

Scapania aspera Bernet, Cat. Hép. Suisse p. 42 (1888) ; Pears., Journ. Bot. p. 353 *pl.* 329 (1892) et Hep. Brit. Isles p. 214 (1900) ; C. Massal., Spec. Ital. Gen. Scap. in Malpighia 16 p. 15 reprint (1903) ; K. Müll., Monog. Scap. p. 187 (1905).



1. Stem with leaves (antical view). 2. Do. (postical). 3. Cells. 4. Section of leaf. 5. Gemmae.

Dioicous. In compact olive-green to reddish-brown tufts. Stems 3–10 cm long, black, paler at the apex, flexuous, erect or ascending, denudate towards the base, usually branched ; rhizoids long, scarce, almost absent above. Leaves approximate below, imbricate above, erecto-patent, embracing the stem, decurrent, ½ divided into two unequal lobes, the antical lobe crossing the stem, *rotund-quadrate*, sometimes apiculate, *convex*, *incumbent*, the margin frequently incurved, slightly

dentate near the apex ; the postical lobe about *a half* larger, broadly *sub-obovate*, the apex *rounded* or occasionally sub-acute, the margin *strongly dentate* except near the base and *broadly reflexed* ; commissure straight or slightly curved ; cells 14–24 μ, oblong-rotund, walls slightly or not thickened, trigones rather large, the marginal cells rounded, smaller, strongly and nearly equally thickened ; *cuticle coarsely verrucose*. Involucral bracts nearly equally bilobed, slightly larger than the leaves. Perianth oblong, slightly narrowed at the apex, the mouth shortly and broadly dentate-laciniate and ciliate. Capsule sub-oval, pale brown Spores 12–15 μ, brown, verruculose ; elaters 8 μ broad, bispiral. Androecium at the apex of the stem, bracts imbricate, resembling the leaves, more nearly equally bilobed ; antheridia 4–7, longly pedicellate, sub-oval, paraphyses linear. Gemmae on the apex of the upper leaves, greenish-white, elliptical, 2-celled, with a few subglobose and 1-celled.

Hab. On rocky ledges, and sand dunes ; calcicolous.

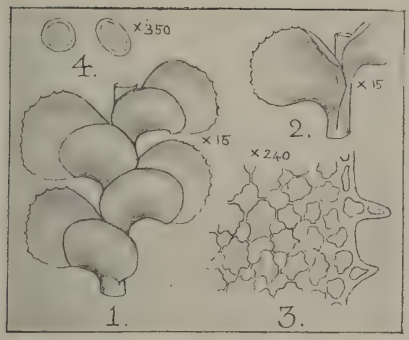
Distrib. N. to Ross and Caithness ?, ascending to 3000 ft. alt. in the Highlands ; rare.

Notes referring to this plant will be found under the allied species. It is not usually difficult to recognise, being a tall species with much the appearance of *S. nemorosa*. It differs from that species in the lobes being generally more equal in size, the antical lobe of a different shape, not cordate at base and only slightly dentate towards the apex, the postical lobe dentate,—while in the other it is ciliate-dentate—, the coarsely verrucose cuticle and the greenish-white gemmae. The last character frequently serves to separate the species in the field, the gemmae of *S. nemorosa* being reddish-brown. *S. aspera* also is calcicolous while the other is rarely so. The two species are, however, sometimes difficult to separate, according to Müller, but they are not so in Britain so far as I have seen.

The teeth on the leaf margin are generally broad at the base, and 1–2, more rarely 3 cells long. They vary considerably in amount, and may even be absent on the antical lobe, with the postical lobe dentate only in the upper third or sometimes subentire.

220. Scapania crassiretis Bryhn

Scapania crassiretis Bryhn, Revue Bryol. p. 7 (1892) ; Kaal., De Dist. Hep. in Norveg. p. 248 (1893) ; C. Massal., Spec. Ital. Gen. Scap. in Malpighia 16 p. 17 reprint (1903) ; Lett, List Sp. Hep. Brit. Isles p. 71 (1902) ; K. Müll., Monog. Scap. p. 181 (1905).



1. Stem with leaves (antical view).
2. Do. (postical). 3. Cells. 4. Gemmae.

Dioicous. In large *slender* tufts, olive-brown to brown below, *reddish-brown above*, sometimes tinged with purple, rarely olive-green. Stems 3–10 cm long, rigid, dark brown to nearly black, ascending, simple or sparingly branched; rhizoids long, rather numerous to near apex of stem. Leaves *rigid*, imbricate, on the branches approximate, hardly accrescent, patent, decurrent, $\frac{1}{2}$–$\frac{3}{4}$ divided into two unequal lobes, the antical lobe slightly or not crossing the stem, *obliquely cordate-reniform* with the apex obtuse, *strongly convex*, *incurved* in the upper half, *usually entire*, less frequently distantly dentate; postical lobe about a half larger, broadly ovate-oval, usually obtuse, margin dentate, the teeth small, acute, 1-celled, in the uppermost leaves frequently ciliate and dentate, with teeth 1–3 cells long, the whole margin broadly reflexed; commissure almost at right angles to stem, keeled, and in the upper leaves winged; cells 15–26 μ, smaller at the margin, rotundate, *trigones brownish-yellow*, *very large*, sometimes confluent, *causing the lumen to be stellate*; cuticle verruculose or only granulate. Gemmae in clusters on the margins of the upper leaves, reddish-brown, sometimes purple, oval, *1-celled*.

Hab. On wet alpine rocks.

Distrib. Wales, Perth.

A slender plant with nearly equally-leaved stems, incurved antical lobe and reflexed postical lobe. It can be known from all our other species by the stellate leaf-cells, the trigones being very large and projecting into the cell cavity. It has a more slender habit than *S. nemorosa*, hardly accrescent leaves, antical lobe obtuse at apex and usually entire, postical lobe dentate with the teeth small and 1-celled except at the apex of the stem, the cuticle rough and the distribution alpine, *S. nemorosa* not ascending above the subalpine region. *S. gracilis* var. *laxifolia*, which occurs on our hills, is nearly always found as scattered stems among mosses; it is yellowish-brown in colour and never has the rufescent or purple tinge which is frequent in *S. crassiretis*, the antical lobe is frequently recurved and many of the gemmae are 2-celled. The present species is more likely to be overlooked in the field for *S. dentata*, which also grows on wet rocks, but the latter is less slender in habit and is darker in colour.

221. Scapania nemorosa (L.) Dum.

Jungermannia nemorosa L., Sp. Pl. p. 1132 (1753); Hook., Brit. Jung. *pl.* 21 f. 3 (1812).

Martinellius nemorosus Gray, Nat. Arr. Brit. Pl. 1 p. 692 (1821).

Scapania nemorosa Dum., Rec. d'obs. p. 14 (1835).

1. Stem with leaves. 2. Cells. 3. Section of leaf.

Dioicous. In *loose*, *green* to olive-green, seldom brown or reddish tufts. Stems commonly 3–6 cm long, dark brown, paler above, erect, recurved at the apex, simple or sparingly branched; rhizoids scarce. Leaves distant or approximate below, subimbricate to imbricate above, accrescent, patent, embracing the stem, decurrent, $\frac{3}{4}$ divided into two unequal lobes, the antical lobe crossing the stem, broadly *cordate-ovate*, *generally pointed*, somewhat *convex*, but occasionally patulous, *ciliate-dentate*, less frequently subentire; postical lobe two to three times as large, *obovate-oval*, the apex rounded or obtuse, *ciliate*-dentate, the teeth usually 2–3 cells long, and 1–2 cells broad at base, the postical margin reflexed; commissure straight or slightly curved, keeled and frequently narrowly winged; cells 16–21 μ, oblong-rotund to hexagonal, of nearly equal size throughout, walls most frequently thin, trigones small, the marginal cells slightly smaller, rather strongly and nearly equally thickened; *cuticle nearly smooth* or granular-papillate. Involucral bracts larger than the leaves and more equally lobed. Perianth oblong-obovate, the mouth shortly lobed, *ciliate* and dentate. Capsule oblong-oval, brown, the inner wall with numerous incomplete, less frequently complete, semi-annular thickenings. Spores 10–14 μ, pale yellowish-brown, finely verruculose; elaters 6–8 μ broad, pale reddish-brown, bispiral. Androecium at the apex of the stem and branches, bracts in 4–5 pairs, imbricate, antical lobe entire, apiculate, ventricose at base, postical lobe somewhat larger, dentate near the apex; antheridia 3–6, oval, longly pedicellate, with linear and subulate paraphyses. Gemmae in *reddish-brown* clusters at the apex of stem and upper leaves, oval, more rarely pyriform, *1-celled*.

var. **alata** (Kaal.) K. Müll., Bull. Herb. Boiss. II p. 608 (1901).

On moist rocks and in wet ground. *Larger than the type and rather flaccid, pale green* above, brown below. Leaves large, the antical lobe broad, *subreniform, more convex, widely crossing the stem*, frequently longly decurrent, the margin denticulate towards the apex or entire; postical lobe obovate-rotundate, the upper half of the margin dentate-ciliate; commissure *frequently strongly arched and keeled*, sometimes with a tooth; cuticle smooth or nearly so.

var. **uliginosa** Jensen in shed.

In *marshes and bogs*; usually *reddish to reddish-yellow*, margin of leaves frequently strongly ciliate-dentate, cuticle *distinctly papillose*; otherwise resembling the type.

HAB. On moist, shady rocks and banks, and occasionally on decaying wood.

DISTRIB. N. to Ross, frequent except in the extreme north; Ireland. Var. *uliginosa*, uncommon.

Distinguished from *S. gracilis* by its broadly cordate and usually pointed antical lobe which is 2–3 times shorter than the postical lobe, by the margin of the lobes, especially of the postical lobe, being ciliate-dentate instead of serrate-dentate, by the ciliate perianth and by the gemmae being almost always 1-celled; also the common form of the present plant is green and it occurs in looser tufts.

S. aspera has a differently shaped antical lobe, the lobes less unequal and not ciliate-dentate, the cuticle coarsely verrucose, the gemmae green and mostly 2-celled, and the plant is calcicolous. The more or less decurrent antical lobe, crossing the stem, of *S. nemorosa*, as well as the ciliate-dentate leaves, etc., will separate red forms of this species from *S. dentata*.

One occasionally, though rarely, meets with plants of this species with the margins only dentate instead of ciliate-dentate; in these cases the other characters of the species must be relied on to distinguish it, but nearly always some leaves can be found on which cilia are present.

The gemmae become dark brown to nearly black with age.

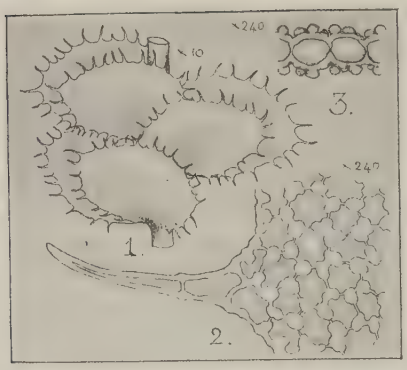
The var. *uliginosa* is widely distributed in Britain; it is usually tinged with red, but the leaves are distinctly ciliate-dentate, and it does not resemble *S. dentata* except in colour.

The var. *alata* is rare, being known only from Wales at present. It resembles a good deal in appearance a green form of the more common var. *uliginosa*. The depth of the keel of the leaves varies considerably in *S. nemorosa*, and is sometimes composed of several cells in the typical plant.

Both these varieties are found in wetter ground than the type. An extreme form, of shady or wet ground, is the var. *fallaciosa* Schiffn. in *Lotos* nr 1 p. 12, 1905. It is very flaccid, green with an occasional tinge of brown, margin of leaves nearly entire to rather distantly dentate, cell-walls thin. This form has not yet been recorded from Britain.

222. Scapania nimbosa Tayl.

Scapania nimbosa Tayl. in Lehm. Pugill. Plant. (1844) et Trans. Bot. Soc. Ed. II p. 115 (1846); G. L. N., Syn. Hep. Suppl. p. 662 (1847); Pears., Hep. Brit. Isles p. 220 (1900).



1. Stem with leaves. 2. Cells. 3. Section of leaf.

Sterile. In *tall, loose reddish-brown tufts* or scattered among mosses. Stems 4–10 cm long, thin, black, frequently denudate towards the base, *erect*, recurved at the apex, usually simple, sometimes with 1–3 long suberect flexuous innovant branches; rhizoids almost absent. Leaves approximate below, imbricate and regularly inserted above, slightly decurrent, *divided almost to the base* into two sub-equal lobes, the antical lobe widely crossing the stem, *semi-cordate-ovate*, pointed or acute at the apex, *convex*, nearly incumbent, erecto-patent, *the whole margin distantly and longly spinous-ciliate*, the teeth 70–160 μ long, *frequently curved*, composed of 1–2 long cells, the base 2-cells broad; postical lobe slightly or to a third larger than the antical lobe, patent, obliquely ovate-oval, acute, the postical base arched and crossing the stem and *strongly reflexed*, the remainder of lobe *convex and decurved*, the margin *spinous as in the antical lobe;* commissure *very short*, keeled; cells 16–22 μ, irregularly rotundate, slightly smaller at the margin, trigones pale yellowish-brown, very large, *the lumen being markedly stellate*, cells at base narrowly obtuse, trigones large, reddish-brown; *cuticle coarsely verrucose* with hyaline papillae.

HAB. On shady rock ledges on the hills.

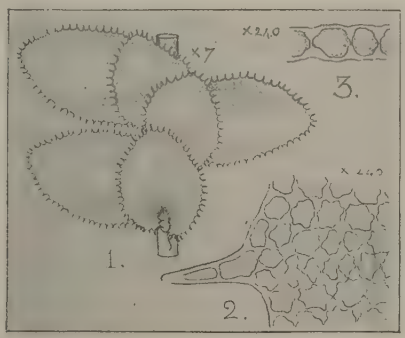
DISTRIB. Wales and the western side of the Highlands, 1700–2500 ft. alt. very rare; Brandon Mountain, Co. Kerry, and Achill Island, Ireland.

This very distinct and fine species can be recognised in the field from *S. ornithopodioides* by its reflexed postical lobe and the long and frequently curved spinous teeth; it is also generally of a rather different colour, being more of a reddish or even yellowish-brown, while the other is of a brighter purple, though sometimes the present plant is also of the latter colour. The habit is different, *S. nimbosa* growing in erect tufts, the other in depressed patches unless when occurring among other species.

This is one of the rarest of our hepatics: it is almost invariably found on rocky ledges with other Atlantic species such as *Mastigophora, S. ornithopodioides, Jamesoniella Carringtoni, Anastrepta*, and *Bazzania tricrenata*. With *S. ornithopodioides* it forms a group distinct from our other species in having the leaves divided to the base. The stems are generally undivided but there is sometimes a single long ascending branch from about the middle of the stem. There are frequently 1–3 innovations from near the apex, although no inflorescence has been detected.

223. Scapania ornithopodioides (With.) Pears.

Jungermannia ornithopodioides With. ex Dill., Bot. Arr. 2 p. 695 no. 14 (1776) *fide* Pearson.
Jungermannia planifolia Hook., Brit. Jung. *pl.* 67 (1814).
Scapania planifolia Dum., Rec. d'obs. p. 14 (1835); K. Müll., Monog. Scap. p. 286 (1905).
Scapania ornithopodioides Pears., Hep. Brit. Isles p. 219 (1900).



1. Stem with leaves. 2. Cells. 3. Section of leaf.

Sterile. In *large reddish-purple patches*, or scattered among mosses. Stems 5–12 cm long, or occasionally longer, black, frequently denudate below, *procumbent*, or erect among mosses, simple or with 1–3 suberect flexuose branches; rhizoids almost absent. Leaves imbricate, very regularly inserted, slightly decurrent, *divided to the base* into two unequal lobes, the antical lobe semi-amplexicaul, convex, incumbent, crossing but *almost parallel in direction to the stem*, roundish-ovate, obtuse or pointed, the whole margin *ciliate-dentate*, with the base spinous-ciliate, the teeth 20–70 μ long, *mostly straight*; postical lobe twice as large, *horizontal*, ovate, obtuse, *flat* or slightly convex, the postical base crossing the stem, hardly reflexed, the whole margin *ciliate-dentate* with the base spinous-ciliate; *commissure absent*; cells 15–21 μ, irregularly oblong to rotundate, slightly smaller at the margin, trigones pale yellowish-brown, *very large*, *the lumen being markedly stellate*, cells at base narrowly oblong; cuticle smooth or slightly verruculose.

HAB. Among shaded boulders, grassy slopes and rock ledges on hills.

DISTRIB. Wales and Cumberland to Aberdeen and Ross, from 1000-2000 ft. alt. in the Highlands, rare.

This large species is easily recognised; it forms large reddish-purple patches on rock ledges and among boulders, in shady but not wet ground. It is the largest species of the genus; the leaves are divided to the base, the antical lobes are closely imbricated and nearly parallel to the stem, while the postical lobes are rather distant from one another and are horizontal and nearly flat.

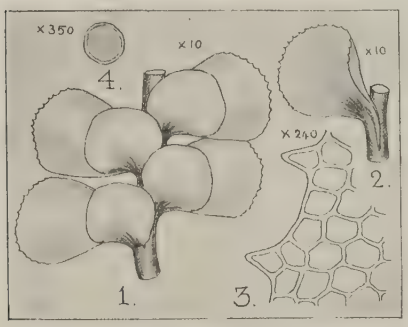
The leaves have usually some small teeth among the longer ones; the teeth are more numerous than in *S. nimbosa* and are commonly straight, except at the base of the leaf where there are a few which are larger and frequently curved. The cuticle is usually slightly verruculose, but is quite unlike the coarsely verrucose cuticle of *S. nimbosa*; the teeth are smooth instead of being verruculose as in the other.

Müller gives a var. *integrifolia* from Norway with quite entire leaf-lobes; this has not been seen in Britain. He states that it is not possible to separate the Himalayan *S. planifolia* from our species; also that the plant from the Hawaiian Islands which Stephani named *S. Baldwini* is the same species.

Schiffner points out in Oest. Bot. Zeit. 1904, that Mitten incorrectly included *S. nepalensis* Nees with this species.

224. Scapania dentata Dum.

Jungermannia nemorosa β purpurascens Hook., Brit. Jung. *pl.* 21 f. 16 (1812).
Scapania dentata Dum., Rec. d'obs. p. 14 (1835); Heeg, Leb. Niederösterr. p. 74 (1893); K. Müll., Monog. Scap. p. 97 (1905).
Jungermannia undulata Nees, Eur. Leb. I p. 184 Series A (1833).
Martinellia undulata β purpurea Lindb., Hep. in. Hib. lect. p. 521 (1875).
Scapania purpurascens Pears., Hep. Brit. Isles p. 225 *pl.* 90 (1900).



1. Stem with leaves (antical view).
2. Leaf (postical). 3. Cells. 4. Gemma.

Dioicous. In compact *purple* or reddish, less frequently dark green tufts. Stems commonly 2–5 cm long, but sometimes to 10 cm or more, black, rigid, denudate below, erect or ascending, simple or with 1–2 branches; rhizoids scarce, absent above. Leaves *firm, not undulate*, closely imbricate, semi-amplexicaul, $\frac{1}{2}$–$\frac{2}{3}$ divided into two unequal lobes, the antical lobe convex, incumbent, *not or seldom crossing the stem, not decurrent*, oval-rotund to cordate-rotund, or subquadrate, apex rounded or subacute, the margin more or less denticulate or entire; postical lobe 2–3 times as large, *obovate*, usually rounded at the apex, rather longly decurrent, *strongly reflexed*, *denticulate*, seldom subentire, the teeth acute, 1–2-celled; commissure straight or nearly so, keeled; cells 16–23 μ, polygonal, walls *slightly and equally thickened*, trigones being absent, marginal cells somewhat smaller, subquadrate, the walls usually rather strongly and equally thickened; cuticle generally finely verruculose. Involucral bracts rather larger than the leaves, lobes more equal and more denticulate. Perianth oblong, the mouth truncate, denticulate, sinuate-dentate or entire. Capsule oval, the inner wall with numerous incomplete semi-annular thickenings. Spores 15–18 μ, reddish-brown, granulate-punctate; elaters 7–9 μ broad, reddish-brown. Androecium at the apex of

the stem and branches, bracts imbricate, in 3–5 pairs, lobes subequal, ventricose at base; antheridia 3–6, globose-oval, on a pedicel of about equal length, paraphyses linear and leaf-like. Gemmae on the apex and margin of upper leaves, greenish-white, broadly oval to rotundate, sometimes ovate, *most frequently 1-celled*, but not seldom 2-celled.

var. **speciosa** Nees, Eur. Leb. I p. 185 (1833).

Jungermannia undulata A ϵ *speciosa* Nees, loc. cit.
Scapania undulata A ϵ *speciosa* Nees in G. L. N., Syn. Hep. p. 66 (1844).
Scapania speciosa Lett, List Hep. Brit. Isles p. 70 (1902).
Scapania dentata β *speciosa* K. Müll., Monog. Scap. p. 101 (1905).

Tall and robust, purplish-red; stems to 12 cm high, firm, simple or slightly branched, closely and equally leaved. Leaves rigid, the antical lobe closely imbricate, convex with the margin *incurved*, *lying on the stem and postical lobe*, entire or nearly so, postical lobe about twice as large, *rotundate* to rotundate-obovate, usually *strongly serrate-dentate*, the postical margin reflexed towards the base; marginal cells with thickened walls; cuticle finely but *distinctly verruculose*.

var. **ambigua** De Not., Scap. Ital. in Mem. Acc. Tor. ser. II p. 359 *pl.* 1 f. 3.

Scapania undulata var. *ambigua* De Not., loc. cit.
Scapania dentata β *ambigua* C. Massal., Spec. Ital. gen. Scap. in Malpighia 16 p. 23 reprint.

Antical lobe rather larger, entire; postical lobe subobovate-rotundate, reflexed, entire or with a few teeth; intermediate between *S. dentata* and *S. undulata*.

Hab. On wet rocks and in springs and stony, marshy ground.

Distrib. N. to Shetland, common in the subalpine and alpine regions, ascending to 3600 ft. alt.; Ireland. Fr. April–July.

The antical lobe is convex and is most commonly entire or with a few teeth near the apex, but in some forms it is dentate or serrate-dentate; the postical lobe is reflexed and is usually serrate-dentate. The leaf-cells vary a good deal in size in the different forms, being sometimes only 15–21 μ in typical plants; the cells near the margin have often strongly thickened walls.

S. dentata differs from *S. undulata* in its rigid and not undulate leaves, the postical lobe broadly obovate and reflexed, the teeth longer and more numerous, the antical lobe frequently dentate, both lobes less rotundate, cells with somewhat thickened walls, and the colour commonly purple. In *S. undulata* the leaves are rather flaccid and usually undulate, the antical lobe in most cases crosses the stem, the postical lobe is generally reflexed only at its postical margin, teeth when present are confined to the uppermost leaves and short and obtuse, and the

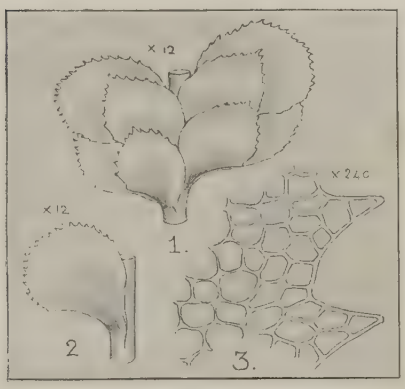
cell-walls thin. Some specimens might, however, be as well placed to the one species as to the other. The var. *ambigua* is intermediate in character between the two, but is, in general, more like *S. dentata* than the other, being more in agreement in the shape of the postical lobe, which is also more or less dentate and is reflexed, and in the firmness of the plant. Under this variety should probably be placed *forma inermis*, stems 4–8 cm long, rigid, leaves approximate, firm, dark purple, antical lobe entire, postical lobe obovate-rotundate, 2–3 times as large as the antical lobe, *entire* or with a few, small, distant teeth on the uppermost leaves. Müller includes all the various forms which are intermediate between *S. dentata* and *S. undulata* in the var. *ambigua*.

Var. *speciosa* is a large and beautiful plant with frequently a brilliant mixture of colours from purple to green and yellow. It is found on wet rocks and on banks where water is constantly present.

A rather frequent plant of the subalpine region on wet rocks, especially when near waterfalls, is *forma minor*, stems 1–2·5 cm long, firm, suberect to erect, leaves rigid, reddish-purple, antical lobe convex, dentate to *serrate-dentate*, on the sterile stems frequently subentire or entire, postical lobe about twice as large as the antical lobe, *oblong-obovate*, reflexed, serrate-dentate. This has the leaf armature of *S. purpurascens* as figured by Pearson. Hooker states that his *Jung. nemorosa β purpurascens* is abundant on the Scotch mountains, but the form which he figures in Plate 21 fig. 16, with both lobes rather strongly dentate, is uncommon on the hills. He mentions that "the lobules in the lower part of the plant appear occasionally to have the teeth nearly obsolete," but he might have added in the upper part also. There is no other species than *S. dentata* on our hills to which his description applies, though it would have been more accurate if he had given the antical lobe as being most commonly subentire or entire.

225. Scapania intermedia (Husnot) Pears.

Scapania nemorosa var. *intermedia* Husnot, Hep. Gall. p. 22 (1875).
Scapania intermedia Pears., Hep. Brit. Isles p. 227 (1900); K. Müll., Monog. Scap. p. 115 (1905).



1. Stem and leaves (antical view).
2. Leaf (postical). 3. Cells.

Dioicous. In small compact, *pale rose* or greenish-white patches. Stems *5–10 mm* long, black or brown, rigid, denudate below, ascending, simple; rhizoids scarce, absent above. Leaves firm, closely imbricate, $\frac{1}{2}$–$\frac{2}{3}$ divided into two unequal lobes, the antical lobe convex, incumbent, not or rarely crossing the stem, not decurrent, *oval* to rotund - quadrate, *apex generally acute or pointed* but frequently obtuse or rounded, *the margin sharply dentate*, teeth 1–2 cells long; postical lobe

twice, seldom three times, as large, oblong-obovate, rounded at the apex, shortly decurrent, *nearly flat*, *the postical margin usually reflexed only at the lower part*, the whole margin *sharply dentate with the upper half serrate-dentate*, the teeth 1–3 cells long; commissure straight, keeled; cells 15–21 μ, polygonal, the walls somewhat *thickened*, especially at the angles, marginal cells smaller, subquadrate with *strongly* and nearly equally thickened walls; cuticle granular-punctate. Involucral bracts rather larger than the leaves, coarsely serrate-dentate. Perianth narrowly oblong, sinuate-entire or dentate. Androecium at the apex of the stem and branches, bracts in 3–5 pairs, ventricose at base, the antical lobe slightly dentate or entire, the postical lobe dentate; antheridia 2–3, globose, on a pedicel of about equal length. Gemmae in greenish clusters on the apex of the uppermost leaves, or scattered on the margin, rotundate or broadly oval, 1–2-celled.

Hab. On moist shady rocks and on decaying logs.

Distrib. Derby and Yorkshire to Forfar, rare. Fr. April–June.

This plant differs from typical *S. dentata* in its small size, pale rose or sometimes greenish colour, the frequently acute or subacute and rather narrowed antical lobe, and the less reflexed postical lobe, but forms of *S. dentata* occur in which most or all of these characters can be seen. Müller doubts if the two can be always separated; I am very doubtful if the present plant be other than a drier ground form of that species. Some plants are found in Scotland which might apparently as well be placed to one as to the other; the size of the leaf-cells, the thickness of the walls and the armament on the margins can be exactly matched in both plants.

On some of the more slender stems, the postical lobe may be curved and reflexed as in typical *S. dentata*.

This plant is generally described as being intermediate between *S. dentata* and *S. umbrosa*; it has the habit and size of the latter, but in no other manner resembles it, and it belongs to a different group in the genus.

The dentate, not ciliate-dentate, leaves, the entire or slightly dentate mouth of perianth, the frequently 2-celled gemmae, etc., will separate it from small forms of *S. nemorosa*.

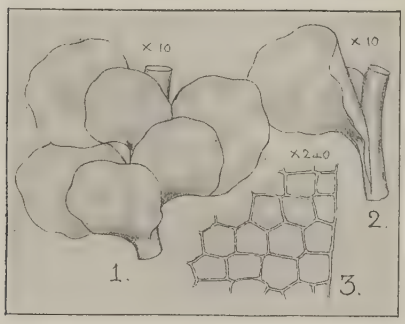
226. Scapania undulata (L.) Dum.

Jungermannia undulata L., Sp. Pl. p. 1132 p.p. (1753); Hook., Brit. Jung. *pl.* 22 (1812); Nees, Eur. Leb. I p. 185 Series B (1833).

Scapania undulata Dum., Rec. d'obs. p. 14 (1835); Pears., Hep. Brit. Isles *pl.* 89 exclud. text. p.p. (1900); Lett, List Sp. Hep. Brit. Isles p. 72 (1902).

Dioicous. In loose or compact pale green or dark green, seldom reddish tufts. Stem 2–8 cm long or more, black, with the leaves mostly destroyed below, erect or ascending, usually much branched; rhizoids scarce, absent above. Leaves *rather flaccid when moist*, *undulate when dry*, imbricate, $\frac{1}{2}$–$\frac{2}{3}$ unequally bilobed, the antical lobe slightly convex, incumbent, generally crossing the

stem, *not decurrent* or very slightly so, *rotund-quadrate or almost circular*, the margin *quite entire;* postical lobe twice as large, in the upper leaves frequently nearly equal, *rotund* - obovate, rather longly decurrent, *entire* or with a few distant obtuse 1-celled teeth on the uppermost leaves, the postical margin *undulate*, reflexed in the *lower* part; commissure nearly straight, keeled, often winged; cells 20–30 μ, polygonal, *walls thin*, *trigones absent*, marginal cells smaller, subquadrate *with thin walls*; cuticle smooth. Involucral bracts rather larger than the leaves, lobes frequently denticulate, teeth 1–2-celled, acute or obtuse. Perianth oblong, truncate, the mouth sinuate-entire or distantly denticulate. Capsule oval, the inner wall with numerous incomplete, seldom complete, semi-annular thickenings. Spores 15–20 μ, brown, finely granular; elaters 8–10 μ broad, reddish-brown. Androecium at the apex of the stem and branches, bracts in 3–5 pairs, imbricate, ventricose; antheridia 3–6, globose-oval, on a pedicel of about equal length; paraphyses linear or subulate. Gemmae in clusters at the apex of the upper leaves, greenish-white, oval to subrotund, *mostly 2-celled.*



1. Stem and leaves (antical view).
2. Leaf (postical). 3. Cells.

Hab. On rocks in streams and in springs and marshes.

Distrib. N. to Shetland, common in the subalpine and alpine regions, ascending to the highest springs in the hills, uncommon in the cultivated regions; Ireland. Fr. May–June.

The typical form of this plant is very distinct; the leaves are green, rather flaccid and more or less undulate and frequently partly destroyed by the action of water; the antical lobe is quadrate-rotund and quite entire, lying on the postical lobe, both being almost flat; the postical lobe is rather longer than broad and rotundate-obovate, either entire or occasionally with a few obtuse, distant teeth which are confined to the uppermost leaves. Notes are given under other species which might be confused with it. Pearson's description in *Hep. Brit. Isles* includes forms with dentate leaves which are generally placed to *S. dentata*, as is done here.

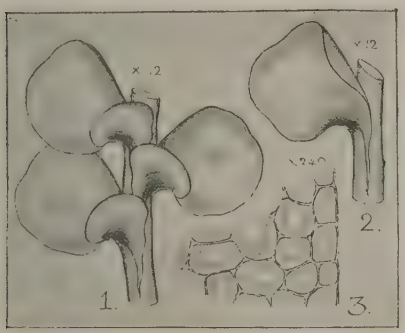
The varieties given by Nees under *S. undulata* cannot now be employed, as he included different species under this name. Müller has had the opportunity of examining Nees' specimens, the results being given in his Monograph.

In this species it is very difficult to give varieties which show any degree of constancy; the different forms seem to depend mainly on the habitat, whether in stagnant or in running water or on wet rocks, also whether on the hills or on the low ground, while the plants of intermediate habitats seem to be intermediate in

their characters. There are at least two very different submerged forms, one being flaccid with several long leafy branches from the lower half of the stem, the other being rigid with numerous stolons from near the base of the stem. I have seen the latter from a hill loch in the Grampians; it may be the forma *flagellaris* of Müller's Monograph, of which, however, I have not seen a specimen. A very distinct form, apparently of wet rocks, has been sent me from Unst, Shetland; it has the habit and appearance of the var. *speciosa* of *S. dentata*, but is rather smaller, 3·5–4 cm long and with the characters of *S. undulata*; it would be interesting to learn how far it is constant. A form, gathered in a mountain stream in Wales by Mr. D. A. Jones, has received the manuscript name of var. *oblongiloba* Schiffn. It is a very flaccid, green plant, with the leaves approximate to distant, the antical lobe oblong-quadrate and the postical lobe oblong-obovate.

227. Scapania uliginosa (Swartz) Dum.

Jungermannia uliginosa Swartz in Lindenb., Syn. Hep. Eur. p. 59 (1829).
Scapania uliginosa Dum., Rec. d'obs. p. 14 (1835).



1. Stem with leaves (antical view). 2. Leaf (postical). 3. Cells.

Dioicous. In large *reddish-brown to purple* or dark green tufts. Stems 5–10 cm long, rather flaccid, black or reddish-brown, with the leaves mostly destroyed below, erect or ascending, simple or frequently with several branches; rhizoids scarce. Leaves slightly flaccid when moist, *crisped when dry*, distant below, approximate to imbricate above, $\frac{1}{2}-\frac{2}{3}$ divided into two greatly unequal lobes, the antical lobe *strongly convex*, incumbent, *rather longly decurrent*, hardly or slightly crossing the stem except in the upper leaves, *reniform*, *quite entire*; the postical lobe *3–4* times as large, undulate, suborbicular, *longly decurrent*, *quite entire*, the postical margin *strongly reflexed*; commissure short, *usually strongly curved*, keeled; cells 20–30 μ, 5–6-angled, walls usually purple, slightly thickened, trigones small, marginal cells smaller, subquadrate with slightly and nearly equally thickened walls, the trigones being minute or absent; cuticle granular-punctate or smooth. Involucral bracts slightly larger than the leaves, less unequally bilobed, the margins entire. Perianth longly exserted, frequently imperfectly formed, oblong-obovate, truncate, the mouth sinuate-entire or slightly denticulate.

Hab. In alpine streams, springs and stony marshy ground.

DISTRIB. Wales and Yorkshire to Aberdeen, from 1800–3600 ft. alt., rarely descending to 900 ft. alt., frequent in the Highlands, rare elsewhere; Ireland. Fr. June–Aug.

This is an easily recognised plant and not likely to be confused except with the closely related *S. obliqua*. The small reniform antical lobe, which is rather longly decurrent, will separate it from *S. dentata* or *S. undulata*; the leaves of the present plant are also quite entire, the antical lobe is strongly convex and the postical lobe longly decurrent. It is never of a pale green colour as in some other aquatic species.

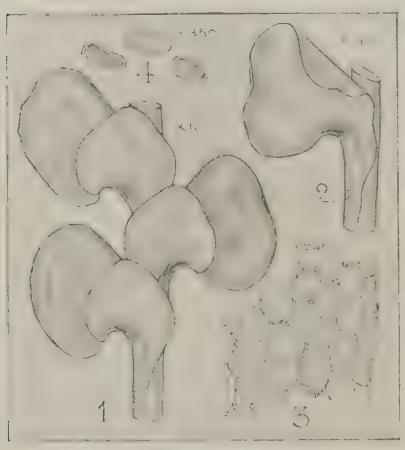
The lumen of the marginal cells is generally coloured even if the other cells are colourless; the trigones are most readily seen when there is no colouring matter in the walls.

Fruit is very rare in this species; perianths are common, but are frequently imperfectly formed.

In this species may be noticed at times several pairs of small leaves on the stem, with the antical lobe sometimes saccate as if it might contain antheridia, but it is not larger than the normal antical lobe, nor have I been able to detect antheridia in them. Nees gives the male bracts as being in 4–6 pairs at the middle of the stem, half as large as the ordinary leaves and nearly equally bilobed, with only one antheridium in each. In *S. obliqua* the antheridia number 3–4 in each bract.

228. Scapania obliqua (Arnell) Schiffn.

Martinellia obliqua Arnell, Revue Bryol. p. 1 (1905).
Scapania obliqua Schiffn., Bry. Fragm. in Oest. Bot. Zeit. No. 1 p. 5 reprint (1905).



1. Stem with leaves (antical view).
2. Leaf (postical). 3. Cells.
4. Gemmae (after Arnell).

Dioicous. In large, swelling compact dull green to *brownish-green* tufts, occasionally with a slight purple tinge. Stems 4–10 cm long, *flaccid*, reddish-brown to nearly black, with the leaves mostly destroyed below, erect, simple or sparingly branched; rhizoids scarce, absent above. Leaves *flaccid* when moist, crisped when dry, distant below, approximate above, $\frac{1}{2}$–$\frac{2}{3}$ divided into two unequal lobes, the antical lobe convex, laxly incumbent, *longly decurrent, widely crossing the stem, obliquely cordate-ovate* rounded at the apex, quite entire;

the postical lobe twice as large, *strongly undulate*, obliquely rotundate, longly decurrent, quite entire or the uppermost leaves with a *few distant, minute teeth*, the postical margin and frequently the *upper half of lobe broadly reflexed;* commissure short, usually strongly curved, keeled; cells 20–30 μ, 5–6-angled, walls usually coloured, slightly thickened, trigones minute, marginal cells smaller, subquadrate, with slightly and equally thickened walls; cuticle smooth or granular-punctate. Involucral bracts slightly larger than the leaves, less unequally bilobed, the margins entire. Perianth longly exserted, oblong, truncate, the mouth entire or remotely and minutely denticulate, the teeth obtuse. Androecium in a terminal spike, bracts in 6–8 pairs, closely imbricate, with the apex of the postical lobe reflexed, $\frac{1}{3}$ bilobed, lobes subequal, strongly ventricose at base; antheridia 3–4, oval, on a pedicel of about equal length; paraphyses numerous, linear to lanceolate. Gemmae (teste Arnell) oval, 1-celled.

Hab. In alpine streams, springs and marshy ground.

Distrib. Wales; Dumbarton to Inverness 1900–2700 ft. alt., rare.

This plant occurs in large swelling tufts at the side of alpine rills and on wet ground on the hills in the same kind of places as *S. undulata* and *S. dentata*; its brownish-green colour attracts attention as being different from either of these, the purple tinge sometimes seen on the uppermost leaves not being generally present; the longly decurrent antical lobe, which can be observed with the lens, will at once distinguish it from either.

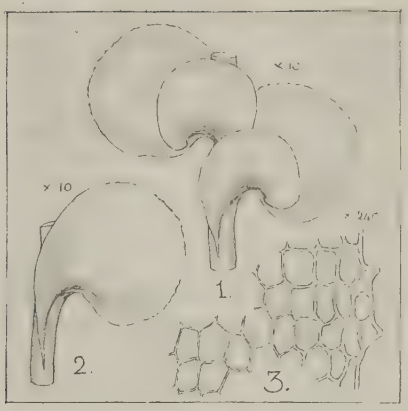
S. paludosa is of a pale green colour, more flaccid and with a highly arched commissure of leaf, antical lobe of different shape and postical lobe occasionally dentate.

S. obliqua is more closely related to *S. uliginosa* than to any other. Although typical forms of the plants differ considerably, they are connected with intermediates. It is as well to keep them distinct, at least for the present, as *S. uliginosa* is a common species on our higher Scottish hills, while the other is uncommon or rare, although the conditions under which they occur are apparently the same; also *S. uliginosa* is not considered to be one of the variable species. *S. obliqua* differs from the typical form of that plant in its green colour, flaccidity, larger leaves, antical lobe of a different shape and widely crossing the stem, the postical lobe undulate and reflexed and sometimes with a few, very small, obtuse teeth on the uppermost leaves; these teeth being very slight protuberances on the margin.

229. Scapania paludosa K. Müll.

Scapania undulata var. *paludosa* K. Müll., Über die 1900 ges. Leb. in Bot. Centralbl. p. 8 reprint (1901).

Scapania paludosa K. Müll., Bull. Herb. Boiss. p. 40 (1903); Monog. Scap. p. 93 *pl.* 8 (1905).



1. Stem with leaves (antical view). 2. Leaf (postical). 3. Cells.

Dioicous. In *large grass-green or yellow-green tufts*. Stems 3–8 cm long or more, reddish-brown or green, *flaccid*, ascending or erect, simple or sparingly branched; rhizoids scarce. Leaves *very flaccid and undulate*, hardly imbricate, $\frac{3}{4}$ divided into two unequal lobes, the antical lobe slightly convex, incumbent, *widely crossing the stem, rather longly decurrent, cordate-reniform*, the apex rounded or apiculate, the margin entire or indistinctly sinuate-dentate in the uppermost leaves; postical lobe 2–3 times as large, almost circular, seldom pointed at the apex, longly decurrent, not reflexed or seldom so, *slightly dentate* or occasionally entire, the teeth short, subacute, mostly 1-celled; commissure short, *semi-circular*, keeled and winged; cells 19–23 μ, 5–6-angled, walls thin, trigones absent, 3–4 rows of *marginal cells* rather smaller, almost quadrate with the walls *thickened*, cells near base with small trigones; cuticle granular-punctate. Involucral bracts slightly larger than the leaves, more equally bilobed, commissure nearly straight, the antical lobe slightly denticulate, the postical lobe shortly dentate. Perianth oblong-oval, strongly reflexed, truncate, the mouth sinuate-entire or almost obsoletely dentate.

var. **vogesiaca** K. Müll., Bull. Herb. Boiss. p. 40 *pl* 1 f. 11 (1903); Monog. Scap. p. 94 *pl.* 8 f. 8 (1905).

Stems usually *reddish*, both lobes of leaf very longly decurrent, the antical lobe *subdentate*, the postical lobe *dentate* or denticulate, teeth 1–2 cells long, acute.

Hab. In alpine marshes.

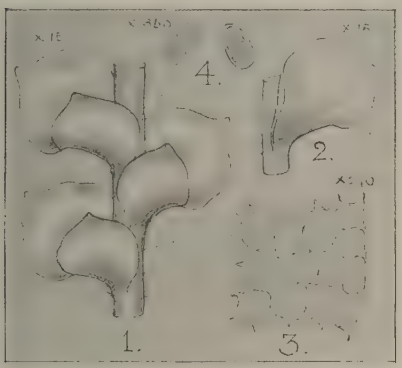
Distrib. Perth to Aberdeen and Ross. Var. *vogesiaca*, Canlochan, Forfarshire.

The short semi-circular commissure, together with the marked flaccidity of the leaves, serve to distinguish this plant. *S. undulata* is sometimes flaccid, but

it has a different commissure and the antical lobe is not decurrent. *S. irrigua* has less flaccid leaves, the lobes generally acutely pointed or apiculate, the antical lobe hardly decurrent and the postical lobe only shortly so, the commissure usually only slightly arched, though occasionally greatly so, and the cells with small but distinct trigones.

230. Scapania irrigua (Nees) Dum.

Jungermannia irrigua Nees, Eur. Leb. I p. 193 (1833).
Scapania irrigua Dum., Rec. d'obs. p. 15 (1835).



1. Stem with leaves (antical view). 2. Leaf (postical). 3. Cells. 4. Gemmae.

Dioicous. In small *yellowish - green*, seldom brownish, tufts, or scattered among mosses. Stems 2–5 cm long, brown or green, rather flaccid, flexuose, ascending, simple or sparingly branched; rhizoids somewhat scarce but *extending to apex of stem*. Leaves rather flaccid, thin, approximate, or imbricate near apex of stem, embracing the stem, ½ divided into two unequal lobes, the antical lobe convex and loosely incumbent or erecto-patent with *the apex incurved*, variously or not crossing the stem, commonly not or hardly decurrent, *cordate-triangular* or subreniform-triangular, *acutely pointed or apiculate*, the margin entire or rarely subdentate near the apex of the uppermost leaves; postical lobe twice as large, frequently undulate, broadly oblong-obovate to *subrotund-obovate*, *apiculate*, shortly decurrent, the postical margin and occasionally the whole lobe reflexed, *the margin entire* or sometimes remotely subdentate near the apex; commissure usually only slightly curved but variable, keeled, and sometimes winged; cells 19–24 μ, roundish-polygonal to roundish-quadrate, translucent, slightly smaller at the margin, walls thin, *trigones small but distinct;* cuticle granular-punctate. Involucral bracts slightly larger than the leaves. Perianth scarcely twice as long as broad, oblong-oval, sometimes plicate above, the mouth truncate, dentate or entire. Capsule oval, the inner wall with complete and incomplete semi-annular thickenings. Spores 9–12 μ, brown, granular. Androecium at the apex or middle of the stem, bracts in 3–4 pairs, smaller than the leaves, ventricose;

antheridia 2–4, broadly oval, on a pedicel of about equal length. Gemmae in clusters at the apex and margin of the uppermost leaves, greenish-yellow, elliptical or oval, 2-celled.

var. **alpina** Bryhn, Nyt Mag. Naturvid. Bd 40 p. 6 (1902).

Yellowish-brown to dark brown, rigid ; leaves *closely imbricated*, firm, the antical lobe *incumbent*, with the margin incurved in the upper part, frequently subdentate near the apex, the postical lobe with the margin usually dentate in the upper third, commissure frequently strongly curved, *cell-walls thickened*, *trigones large*, cuticle verruculose.

HAB. On wet grassy ground, marshes and bogs and on wet banks.

DISTRIB. N. to Shetland, generally distributed but rather uncommon ; Ireland. Var. *alpina*, Breadalbane Mountains, on rock ledges to 3200 ft. alt.

Can nearly always be distinguished from *S. undulata* by the presence of trigones, which are small but distinct, and by the rhizoids extending along the whole length of the stem except in the younger parts ; the lobes are usually pointed and the antical lobe more or less reniform-cordate ; the colour of the plant is generally distinctive, being dirty yellowish-green and of rather a greasy appearance ; it is found usually growing on soil, most frequently in marshy ground, and rarely, if ever, directly on rocks ; it generally occurs only in small patches. *S. subalpina* has more equal lobes which are also usually dentate, the antical lobe more rotundate, the marginal cells nearly always with thickened walls and much smaller than at the middle of the leaf, the postical lobe longly decurrent ; the last character will distinguish the forms of *S. subalpina* with thin cell-walls. Some specimens of the present plant are, however, difficult to separate from it and from *S. undulata*. The commissure of leaf is variable, especially in subalpine forms ; in these it is sometimes considerably, though seldom much, curved. The perianth is comparatively shorter than in the allied species.

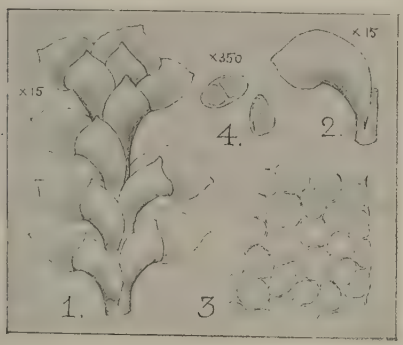
The var. *alpina* is a distinct plant, being rather taller and stouter than the type, much more rigid, and the colour and cell structure quite different. Arnell states in *Die Moose des Sarekgebietes* that it is closely related to *S. hyperborea* Jörgens.

231. Scapania curta (Mart.) Dum.

Jungermannia curta Mart., Fl. Crypt. Erlang. p. 148 (1817).
Scapania curta Dum., Rec. d'obs. p. 14 (1835) ; G. L. N., Syn. Hep. p. 69 (1844).

Dioicous. In *small*, depressed, loose, yellowish-green tufts. Stems 1–2 cm long, brown, ascending or erect, usually simple but frequently with an innovation from below the perianth ; rhizoids numerous below, scarce to absent above. Leaves approximate to imbricate, slightly or not accrescent, not decurrent, $\frac{1}{3}$ divided into two unequal lobes, the antical lobe erecto-patent, not crossing the stem, *ovate to quadrate-ovate*, usually acute, *entire*, or occasionally serrate-dentate towards the apex ; postical lobe about twice as large

or frequently only a half larger, *almost flat*, oblong-obovate, the apex acute, apiculate or rounded, the margin entire or slightly dentate; commissure slightly curved or straight, keeled; cells 18–25 μ, roundish-oval, walls thin, *trigones generally rather small* but always distinct, marginal cells slightly smaller, frequently subquadrate, the walls considerably and nearly equally thickened; cuticle smooth or slightly granulate. Involucral bracts rather larger than the leaves and more equally bilobed, sometimes undulate. Perianth oblong-obovate, subplicate above, the mouth truncate, irregularly dentate and dentate-ciliate, the teeth 1–2 cells long, but sometimes only sinuate-dentate. Capsule oval. Spores 8–10 μ, finely papillose. Androecium at the apex of the stem, bracts in 4–6 or more pairs, imbricate, frequently tinged with reddish-brown, almost equally bilobed, ventricose; antheridia 2–3, oval. Gemmae on the apex and margins of the upper leaves, greenish-yellow, variable in shape, elliptical to oblong, sometimes nearly pyriform or slightly angular, 1–2-celled.



1. Stem with leaves (antical view).
2. Leaf (postical). 3. Cells. 4. Gemmae.

var. **geniculata** (C. Massal.) K. Müll., Bull. Herb. Boiss. p. 600 (1901); C. Massal., Spec. Ital. Gen. Scap. Malpighia 16 p. 32 reprint (1903).

Scapania geniculata C. Massal., Hep. Venet. Fasc. 1 p. 20 *pl.* 1 (1879).

Prostrate, green, *branches often geniculate*. Leaves imbricate, accrescent, *quite entire*, the antical lobe *rhomboid-oval*, commonly *rounded-obtuse at the apex*, sometimes crossing the stem, postical lobe obovate-oval, the apex *rotundate*. Perianth usually entire.

HAB. On moist banks and sides of ditches.

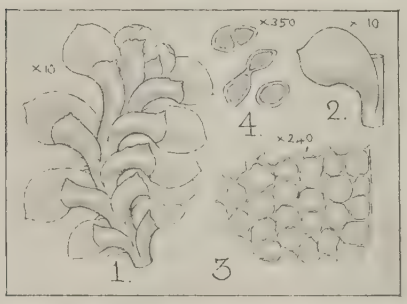
DISTRIB. N. to Shetland, frequent; Ireland. Var. *geniculata*, Balmoral, 1884 (*G. Stabler*).

This is not likely to be confused except with *S. rosacea* or with small forms of *S. irrigua*. *S. curta* differs from the latter in having the lobes less deeply divided, antical lobe not cordate, postical lobe frequently rounded at the apex and concave or slightly convex, not widely reflexed as is frequently the case with *S. irrigua*, cells with thicker walls and larger trigones; also it is most commonly found on loamy banks.

The var. *geniculata*, with its rounded apex of leaves, has much resemblance to *S. helvetica* Gottsche, which is referred to under *S. rosacea*. The variety is rather a smaller plant, leaves less rigid and more accrescent, trigones smaller. The antical lobe of the sterile stems is sometimes apiculate.

232. Scapania rosacea (Corda) Dum.

Jungermannia rosacea Corda in Sturm., Deutsch. Fl. II p. 96 *pl.* 29 (1832).
Scapania rosacea Dum., Rec. d'obs. p. 14 (1835); G. L. N., Syn. Hep. p. 71 (1844).
Scapania curta var. *rosacea* Carr., Brit. Hep. p. 87 (1876); K. Müll., Monogr. Scap. p. 247 (1905).



1. Stem with leaves (antical view).
2. Leaf (postical). 3. Cells. 4. Gemmae.

Dioicous. In small depressed, *rosy* or brownish-yellow tufts. Stems ·5–1 cm long, rather soft and thick, usually dark reddish-brown below, rosy above, simple but occasionally innovating, *prostrate with the apex ascending*; rhizoids *long and numerous to near apex of stem*. Leaves approximate below, *closely imbricate above*, *distinctly accrescent*, not decurrent, $\frac{1}{2}$ divided into two unequal lobes, *the antical lobe convex and loosely incumbent*, not crossing the stem, ovate, usually apiculate in the lower leaves and acute in the upper leaves, dentate towards the apex or entire; the postical lobe twice as large, obliquely oblong-oval to oblong-obovate, *the apex rounded and frequently apiculate*, the postical margin slightly reflexed and with the apex somewhat decurved; commissure nearly straight, keeled; cells 18–22 μ, sometimes to 30 μ, roundish-oval, walls thickened, *trigones large*, *the lumen being frequently substellate;* cuticle verruculose. Involucral bracts rather larger than the leaves. Perianth oblong-obovate, subplicate above, the mouth truncate, entire or subdentate. Androecium at the apex of the stem, bracts in few pairs, very closely imbricate, rosy or purple, almost equally bilobed, ventricose, the antical lobe reflexed at the apex; antheridia 2–3, broadly oval, paraphyses linear and lanceolate. Gemmae on the margin of the upper leaves, greenish-yellow, elliptical, oval or oblong-rotund, 1–2-celled.

Hab. On moist banks and wet rock ledges in the subalpine and alpine regions.

DISTRIB. Cheshire and Yorkshire to Caithness, rare.

Differs from *S. curta* in being smaller, generally rosy, stems softer, less erect and with numerous rhizoids, leaves more imbricate and more distinctly accrescent, the antical lobe convex with the apex somewhat incurved, cells with strongly thickened walls, especially at the angles. It is however sometimes difficult to separate from *S. curta*, and some of our plants appear to belong as well to the one as to the other. Arnell in *Die Moose des Sarekgebietes* considers it to be a fairly well defined species, and mentions that out of about 300 Swedish specimens which he examined, he scarcely found one about which he had any doubt. It is perhaps doubtful if northern botanists give the same limitations to the two plants as do the southern botanists, but it is probable that in the north of Europe the characters of *S. rosacea* are better defined than they are in the south.

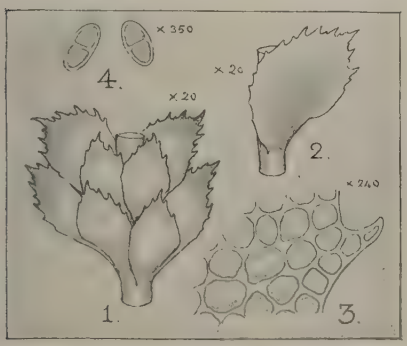
The leaf-cells vary considerably in size; the South European plant seems to have them larger than the northern has, judging from the specimens which I have examined, but I cannot find any other difference.

Small forms of *S. irrigua* may have some resemblance to *S. rosacea*, but the latter has thicker cell-walls and larger trigones, and the lobes are of a different shape.

S. helvetica Gottsche, which may probably occur on some of our higher hills, is much like *S. rosacea*; it is rather a larger and less delicate plant, the trigones rather large, antical lobe generally rounded or obtuse at the apex, patent when moist and incurved when dry; the postical lobe is reflexed and is usually rounded at the apex as in most of our British *S. rosacea*.

233. Scapania umbrosa (Schrad.) Dum.

Jungermannia convexa Scop., Fl. Carn. ed. 2 p. 349 (1772)?
Jungermannia umbrosa Schrad., Syst. Samml. Crypt. Gew. 2 p. 5 (1797); Hook., Brit. Jung. *pl.* 24 (1812).
Scapania umbrosa Dum., Rec. d'obs. p. 14 (1835).
Scapania convexa Pears., List Canad. Hep. p. 15 (1890).



1. Stem with leaves (antical view).
2. Leaf (postical). 3. Cells. 4. Gemmae.

Dioicous. *Small.* In whitish-green to yellowish-green or occasionally rosy tufts. Stems ·5 – 2 cm long, reddish-brown, pale above, flexuose, ascending, frequently decurved at the apex, simple or sparingly branched; rhizoids scarce, absent above. Leaves accrescent and imbricate above, not decurrent, $\frac{2}{3}$ divided into two unequal lobes, the antical lobe slightly convex, *closely imcumbent*, not crossing the stem, *ovate*, *acute*, *nearly parallel*

to the stem, *serrulate-dentate* towards the apex; the postical lobe 2–3 times as large, *oblong-ovate*, *acute*, decurved and frequently almost secund, *serrate-dentate* in the upper half, seldom sub-entire; commissure nearly straight, forming an acute angle with the stem, keeled; cells 16–25 μ, roundish, walls usually considerably thickened, trigones large, marginal cells smaller, subquadrate, the walls strongly and nearly equally thickened; cuticle granular-punctate. Involucral bracts larger than the leaves, more equally bilobed and less dentate. Perianth longly exserted, frequently rosy purple at the base, oblong, the mouth truncate, sinuate-entire. Capsule oval-oblong, reddish-brown, inner wall with complete and incomplete semi-annular thickenings. Spores 8–10 μ, pale reddish-brown, finely punctate; elaters 6–7 μ broad, reddish-brown. Androecium at the middle or apex of the stem, bracts in 4–6 pairs, imbricate, smaller than the leaves, *the lobes equal*, *subrotund and entire*, ventricose, generally rosy-purple; antheridia 1–2, broadly oval, shortly pedicellate. Gemmae in reddish-brown clusters at the apex of the stem, elliptical-oblong, 2-celled.

Hab. On decaying logs, stumps, peaty banks and half-buried rocks in moist sheltered places, usually in subalpine districts.

Distrib. N. to Shetland, rare in the S. of England and in the drier districts; Ireland. Fr. March–May.

This is such a distinct species that it can hardly be mistaken; the antical lobe is nearly parallel to the stem, and both lobes are narrow, acute and serrate; occasionally the lobes are subentire in young or depauperate plants, but the shape and direction of the antical lobe remains characteristic.

Subfamily Raduloideae

Raduleae Spruce; *Stephaninoideae* Schiffn.

Plants rather large, rarely small, usually forming depressed patches. Stems arising from a rhizomatous base, prostrate, laxly pinnate or sub-pinnate, branches all lateral and *infrafoliar* in origin. Leaves incubous, *complicate-bilobed*, margins nearly always entire, *the postical lobe smaller* with its free margin generally appressed to the underside of the antical lobe, *the rhizoids arising from a mamilliform protuberance near its fold. Underleaves everywhere absent.* ♀ inflorescence acrogenous, frequently with 1–2 sub-floral innovations, very rarely cladogenous. Archegonia 5–16. *Perianth usually strongly frontally*

compressed, rarely sub-terete, very rarely plicate, *the mouth wide, truncate, bilabiate.* Capsule shortly and stoutly pedicellate, generally oval-cylindrical, 4-valved to the base, the walls of two layers of cells. Spores large, globose. Elaters long, slender, obtuse, closely bispiral. Androecia spicate, usually terminal on the branches, bracts with 1–2, rarely 3 antheridia. Gemmae discoid, arising from the margin of the leaf.

LXI. RADULA Dum.

Radula Dum. p.p., Comm. Bot. p. 112 (1822); Rec. d'obs. p. 14 (1835).
Martinellius S. F. Gray p.p., Nat. Arr. Brit. Pl. 1 p. 691 (1821).
Stephanina O. Kuntze, Rev. Gen. Pl. p. 839 (1891); Schiffn. in Engl. and Prantl, Nat. Pflanz. I 3 p. 113 (1895).

Characters of the subfamily.

There is no difficulty in recognising this genus, it having the unique character of the rhizoids being attached to the postical lobe of the leaf; there are also none of our other genera with the same habit, except *Madotheca*, *Lejeunea* and *Frullania*, and these have easily observed underleaves.

The species of *Radula* show much uniformity, making it sometimes difficult to separate them. The most important character in general is the shape and position of the postical lobe, and whether it be inflated or not at the base. The only common species in Britain, *R. complanata*, is however readily known by its paroicous inflorescence, which is nearly always present; *R. Lindbergii* is subalpine and alpine, and the remainder are atlantic.

1 { Postical lobe large, rounded-cordate, widely crossing the stem ...*239. voluta*
  { Postical lobe more or less quadrate, not or little crossing the stem 2

2 { Paroicous; usually with perianth.....*234. complanata*
  { Dioicous; rarely with perianth.....3

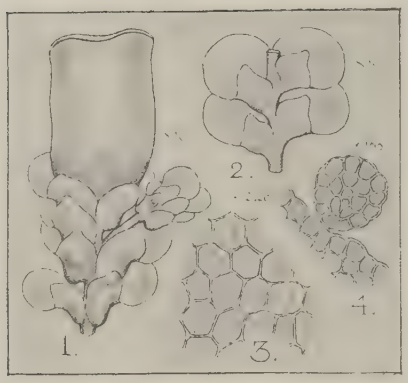
3 { Mature leaves very convex, brown; postical lobe tumid.....*237. aquilegia*
  { Mature leaves flat or slightly convex, brown or green; postical lobe flat.....4

4 { Usually green, margin of leaf frequently gemmiferous.....*235. Lindbergii*
  { Olive or reddish-brown, gemmae absent.....5

5 { Postical lobe quadrate, 4–5 times smaller than the antical lobe, antical lobe crossing the stem .....*236. Carringtonii*
  { Postical lobe obliquely ovate, 5–7 times smaller than the antical lobe, antical lobe not crossing the stem; plant much smaller .....*238. Holtii*

234. Radula complanata (L.) Dum.

Jungermannia complanata L., Sp. Pl. p. 1133 (1753).
Radula complanata Dum., Comm. Bot. p. 112 (1822).



1. Fertile plant. 2. Stem with leaves. 3. Cells. 4. Gemma.

Paroicous. In thin, usually pale *yellow-green* patches. Stems 2–5 cm long, prostrate, irregularly and laxly pinnate; rhizoids confined to the underside of the postical lobes of the leaves. Leaves distant below, closely imbricate above, *patent*, the margins entire, unequally bilobed, the antical lobe rotundate, broader than long, crossing the stem, nearly flat, the postical lobe 4–5 times smaller, almost quadrate, not crossing the stem, appressed to the antical lobe, the outer angle obtuse, seldom acute; cells 20–25 μ, roundish-polygonal, opaque, being filled with numerous chloroplasts and with 1–3 granular oil-bodies, walls thin, trigones small; cuticle smooth. Involucral bracts embracing the perianth, the antical lobe elongate-obovate, the postical lobe about half as large, ovate to subquadrate; sub-involucral bracts in 2–3, seldom more, pairs, resembling the involucral bracts, ventricose; antheridia single, globose, shortly pedicellate. Perianth terminal on the stem or branches, *obconical*, compressed, nearly flat, the mouth wide, truncate, entire. Capsule oval, shortly pedicellate, brown, the wall of two layers of cells, the inner wall with nodular thickenings. Spores 25–40 μ, pale yellow-brown, thickly papillose; elaters 6–7 μ broad, bispiral, yellow-brown. Gemmae usually scarce, on the margins of the leaves, discoid, generally multicellular with chloroplasts and an oil body.

Hab. On trees in moist and somewhat shaded localities, also not rarely on rocks in damp and well sheltered places.

Distrib. N. to Orkney, generally distributed and frequent except in dry exposed districts; Ireland. Fr. March–June, common.

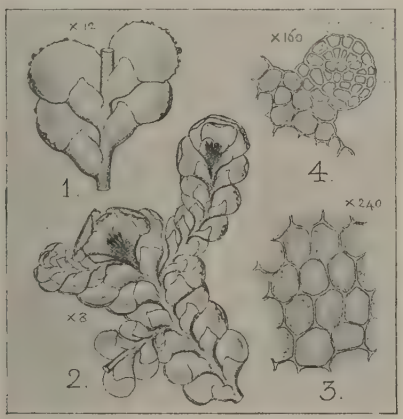
There is seldom any difficulty in distinguishing this common species, as its paroicous inflorescence can nearly always be detected; the characteristic swollen male bracts retain this appearance for some time after the fruit is mature, and if not, they can be seen containing antheridia below the young female inflorescence at the end of some of the branches; this refers to the plant in its most common habitat, viz., trunks of trees, in which position perianths are very commonly present and fruit common. When the plant occurs on rocks, it is generally of a darker colour and is most commonly sterile, but it seldom happens that the paroicous inflorescence cannot be detected; it is only with *R. Lindbergii* that any difficulty can be found, and inflorescence is rarely absent in either when on the low ground, to which *R. complanata* is almost confined. Although

gemmae are not so common in this species as in *R. Lindbergii*, their presence or absence is not a distinguishing character of any importance, as they may be seen sometimes abundantly even in fruiting specimens of *R. complanata*.

The leaves towards the upper parts of the branches are usually erecto-patent; although generally nearly flat they are occasionally sometimes convex.

235. Radula Lindbergii Gottsche

Radula Lindbergii Gottsche in Hartm., Skand. Fl. ed 2 II p. 98 (1864).
Radula commutata Gottsche ex Jack in Flora Nos. 23 and 25 (1881).



1. Stem with leaves. 2. Plant with sterile archegonia. 3. Cells. 4. Gemma.

Dioicous. In *dark yellow-green or green*, sometimes greenish-brown patches, generally rather smaller and more tender than *R. complanata*. Stems to 3 cm long, prostrate, or ascending among mosses, irregularly and loosely subpinnate, the branches ascending. Leaves closely imbricate, erecto-patent or patent, the antical lobe obovate-rotundate, crossing the stem, *nearly flat* or occasionally somewhat convex, the postical lobe 3–4 times smaller, almost quadrate, not crossing the stem, *appressed to the antical lobe*, the outer angle obtuse or acute; cells 20–24 μ, occasionally to 30 μ, roundish-polygonal, opaque, walls thin, trigones minute; cuticle smooth. Involucral bracts nearly resembling the leaves. Perianth terminal on the stem or branches, oblong-obovate or oblong, compressed, nearly flat, the mouth wide, truncate, entire. Capsule oval, brown, shortly pedicellate, inner wall with nodular thickenings. Spores 20–33 μ, pale yellow-brown; elaters 6–7 μ broad, bispiral, pale reddish-brown. Androecium terminal or at the middle of the stem, *in long green spikes composed of 8–15 or more pairs* of closely imbricate, suberect, nearly equally bilobed and ventricose bracts; antheridia single, globose. *Gemmae numerous* on the margin of the leaves and bracts which are thus very often erose, discoid, resembling the gemmae of *R. complanata*.

var. germana (Jack)

Radula germana Jack in Flora Nos. 23 and 25 (1881); Pears., Hep. Brit. Isles p. 70 (1899).

In *small compact cushions on alpine rocks* or as scattered stems among mosses, *pale green* to pale yellowish-green, *smaller than the type* and with smaller leaves, otherwise resembling it.

HAB. On wet rocks in subalpine ravines and on rocks on the hills. Var. *germana*, on rocks on the hills.

DISTRIB. Wales to Caithness, uncommon; var. *germana*, Dumbarton to Forfar, ascending to 3900 ft. alt.

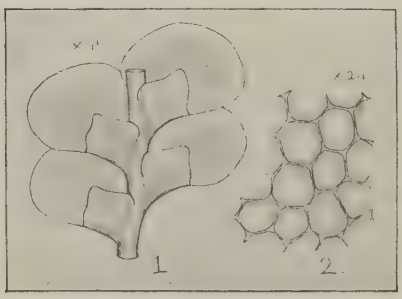
When this species occurs on the low ground it cannot be distinguished with certainty from *R. complanata* except by the inflorescence: fortunately this is nearly always present, the plants showing sterile archegonia at the apex of the stems and of the branches, and being without swollen subinvolucral bracts, as in the paroicous *R. complanata*. When at a considerable altitude on the hills, the plant usually occurs as the var. *germana* in small compact cushions or scattered among mosses. These alpine forms are not generally like *R. complanata* in appearance, but sometimes they can only be definitely recognised from that species by examining the inflorescence; they are mostly female or without inflorescence, and as *R. complanata* is a low ground plant, rarely occurring on the hills, there need not as a rule be much hesitation in assigning the plant to *R. Lindbergii*. The male plant is rare in Britain and is almost always confined to the hills; the long spicate androecia at once distinguish it. As mentioned under other species, the immature leaves on the branches are frequently considerably convex in *R. Lindbergii*, but the leaves on the mature stems do not as a rule show this character.

Most authors give *R. germana* as a synonym of *R. Lindbergii*, and Lindberg in *Musc. Asiae. Bor.* p. 16 considers that it scarcely differs from that species and can only be taken as a variety. It is sometimes distinct in appearance, but is connected by many intermediate forms, so that many specimens can only be doubtfully placed to one or the other. It frequently turns nearly white on exposed alpine rocks.

236. Radula Carringtonii Jack

Radula aquilegia var. *major* Carr., Trans. Bot. Soc. Ed. 7 p. 455 (1863); Lindb., Hep. in Hib. lect. p. 491 (1875).

Radula Carringtonii Jack in Flora No. 23 (1881); Pears., Hep. Brit. Isles p. 76 (1899).



1. Stem with leaves. 2. Cells.

Dioicous. In usually shallow *olive-brown or yellow-brown* to olive-green patches. Stems 2·5–4·5 cm long, *slender*, *flexuous*, pale brown, prostrate, irregularly and usually distantly subpinnate, occasionally bipinnate, the branches ascending, flexuose, frequently narrowed towards the extremities. Leaves equally and slightly imbricate, *horizontal*, somewhat pellucid, the antical lobe

subovate-rotundate, broad at the base, crossing the stem, slightly convex to almost flat, the apex frequently slightly inflexed, the postical lobe 4–5 times smaller, almost quadrate, not crossing the stem, *nearly flat, appressed to the antical lobe*, the *outer margin parallel to the stem*, the outer angle subacute or obtuse, the keel straight or slightly convex; cells 19–23 μ, roundish-polygonal, the walls thin, trigones minute; cuticle smooth. Involucral bracts rather smaller than, or of the same size as the leaves, the antical lobe rotund-obovate, the postical lobe 2·5–3 times smaller, oblong-ovate, the apex rounded. Perianth terminal on a short lateral branch proceeding from the main stem or branches, usually with an innovation, longly exserted, oblong, the base narrowed for some distance and swollen, compressed above, the mouth wide, truncate, bilabiate, entire. Androecium in a long narrow brown spike, commonly occupying the whole of a lateral branch, but sometimes only the apex or middle, bracts in 5–12 pairs, much smaller than the leaves, erect, closely imbricate, nearly equally bilobed, ventricose and *strongly pendulous at base*. *Gemmae absent*.

Hab. On moist or wet shaded rocks.

Distrib. West Inverness; very rare; West of Ireland, rare.

Is more tender than *R. Lindbergii* or *R. complanata* and is a more slender plant and darker in colour, leaves horizontal and less imbricate and never gemmiferous; the usual form of the species is reddish-brown and not like either of the above, but it is occasionally of a paler colour; in this latter case, besides the vegetative characters, the inflorescence will at once distinguish it, as the male plant of *R. Lindbergii* is confined to the hills, while *R. Carringtonii* is only found on the low ground, and *R. complanata* is paroicous.

The antical lobe is of a different shape from that of *R. aquilegia*, being rotundate and not narrowed at the base, as may be seen by dissecting off the leaves; it is also horizontal, not erecto-patent. The postical lobe, though flat or nearly so, is not actually appressed to the antical lobe, but it forms an acute angle with it at the base, and nearly lies on it, the upper margin being flat. On the younger leaves the postical lobe is somewhat tumid. Its outer margin is parallel to the stem which is not the case in *R. aquilegia*.

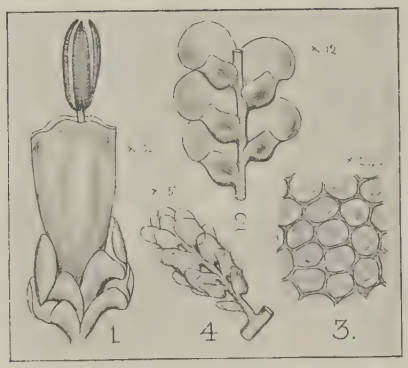
Sterile forms of *R. Holtii* can be known from *R. Carringtonii* by the antical lobe not crossing the stem; also by the differently shaped postical lobe, except in the case of the male plant.

237. Radula aquilegia Tayl.

Jungermannia complanata β minor Hook., Brit. Jung. *pl.* 81 f. 17 (1816).

Jungermannia aquilegia Tayl., Journ. Bot. p. 291 (1844) et Trans. Bot. Soc. Ed. II p. 117 (1846).

Radula aquilegia Tayl. in G. L. N., Syn. Hep. p. 260 (1844).



1. Fertile plant. 2. Stem with leaves. 3. Cells. 4. Androecium.

Dioicous. In wide depressed *reddish-brown* patches. Stems 3–5 cm long, slender, flexuous, brown, prostrate, irregularly pinnate, sometimes bipinnate, the branches frequently rather numerous, *mostly horizontal*, and usually short and flexuose. Leaves equally and slightly imbricate, *erecto-patent*, the antical lobe *obovate*-rotundate, *narrowed at the base*, crossing the stem, *convex*, the margins *inflexed* especially at the apex, the postical lobe 4–6 times smaller, oblong-quadrate, not crossing the stem, *strongly inflated at the base*, the upper margin *appressed* to the antical lobe, the outer margin not parallel to the stem, outer angle of lobe obtuse, the keel convex; cells 15–21 μ, roundish-polygonal, the walls slightly thickened, trigones small; cuticle smooth. Involucral bracts nearly resembling and frequently rather smaller than the leaves, the outer angle of postical lobe usually rounded. Perianth terminal on a short or long branch proceeding from the main stem or branches, usually with 1–2 innovations, but sometimes from the side of the stem without innovations, very longly exserted with a long neck, oblong, subcompressed below, flat above, the mouth wide, truncate, entire. Capsule broadly oval, brown, very shortly pedicellate, inner layer of wall with *strongly nodular thickenings*. Spores *45–54* μ, rotundate, pale greenish-brown, almost translucent, finely echinate; elaters 6–7 μ broad, reddish-brown. Androecium on a short spike occupying the whole, or less frequently only the apex, of a lateral branch, bracts in 3–5 pairs, much smaller than the leaves, erect, closely imbricate, almost equally bilobed, ventricose and strongly pendulous at base. Gemmae absent.

HAB. On moist shaded rocks and trees.

DISTRIB. Wales to West Ross, rare; west and north of Ireland, rare. Fr. May–Nov.

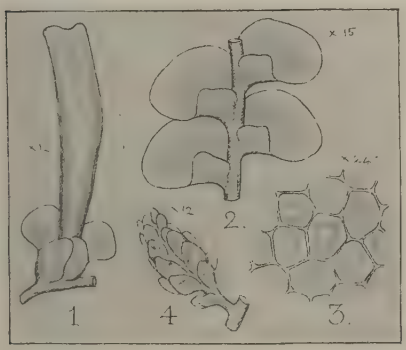
This is the most frequent of the atlantic species of the genus, and is easily recognised in the field by the rather large reddish-brown, or when dry, yellowish-brown patches, and its convex leaves, the apex and frequently the upper part of the postical margin being inflexed; also by the postical lobe being strongly inflated at the base with the apex appressed to the antical lobe. The younger parts of all our species are sometimes brownish in colour and with the postical

lobe frequently somewhat inflated, but on the mature stems this lobe is rarely inflated, and even if it be so, the upper part is not appressed to the antical lobe. *R. aquilegia* is also distinguished by the antical lobe being distinctly narrower towards the base, and by the leaves being erecto-patent on the mature stems; in the other species they are not erecto-patent unless on the younger stems.

The male plant is uncommon, the female is common; they seldom occur in the same patch. Fruit is very rarely found when on wet rocks, but is not very rare when on trees; as the latter habitat is drier, the plant when occurring there is of a lighter colour; when on trees it is more frequently mixed with other hepatics and mosses, and when on rocks it is usually in unmixed patches.

238. Radula Holtii Spruce

Radula Holtii Spruce, Journ. Bot. p. 209 (1887); Pears., Hep. Brit. Isles p. 72 (1899).



1. Fertile plant. 2. Stem with leaves. 3. Cells. 4. Androecium.

Dioicous. In small and shallow *olive-green* to slightly *reddish-green* patches or as scattered stems creeping over mosses. Stems 1·5–2·5 cm long, slender, flexuose, pale brown, prostrate, irregularly and distantly pinnately, and frequently bipinnately branched in the ♀ plant, the branches patent or ascending, flexuose. Leaves distant below, *approximate* to subimbricate above, *horizontal* and somewhat decurved, rather pellucid, the antical lobe obovate-rotundate, *not crossing the stem*, nearly flat, postical lobe *5–7* times smaller, *obliquely-ovate*, not crossing the stem, somewhat inflated at the base, *inflexed above*, the outer margin parallel to the stem, the outer angle rounded or obtuse; the postical lobe in the ♂ plant 4–5 times smaller than the antical lobe, subquadrate and nearly flat except at apex of the stem; cells 16–23 μ, 5–7-angled, opaque, the walls thin, trigones very minute; cuticle smooth. Involucral bracts nearly resembling the leaves. Perianth terminal on the stem or on a branch, with 1–2 divergent or suberect innovations from the base of the involucral bracts, 2–3 mm long, very longly exserted, narrowly *linear-trumpet-shaped*, the lower half nearly terete; subcompressed above, the mouth flattened and complanate, lobulate-truncate. Capsule *cylindrical*, 8 mm long, dark reddish-brown, very shortly pedicellate, inner layer of wall with *indistinct and irregular nodular thickenings*. Spores 16–22 μ, rotundate or irregularly oblong, greenish-yellow to pale yellow-brown, smooth;

elaters 110–180 μ long and 5–7 μ broad, pale reddish-brown, bispiral. ♂ plant distantly subpinnate with long sterile branches, and with short branches bearing androecia. Androecium on a short brown spike, occupying the whole or more rarely only the apex of a lateral branch either of the main stem or branches; bracts in 2–3 pairs, much smaller than the leaves, suberect and closely imbricate, nearly equally bilobed, ventricose but *not pendulous* at base. Gemmae absent.

HAB. On wet dripping rocks.

DISTRIB. Killarney, very rare.

Is a very distinct species, the perianth being very different in shape from that of the others; sterile plants can be known by the antical lobe not crossing the stem and by the ovate postical lobe. The leaves are not erecto-patent as in *R. aquilegia* and the antical lobe is not markedly narrowed towards the base as in that plant, nor is its margin inflexed; it has more resemblance, especially in the male plant, to small forms of *R. Carringtonii*. In the field it can be generally distinguished by its olive-green colour and rufescent tinge; small forms of *R. Carringtonii* are without this tinge.

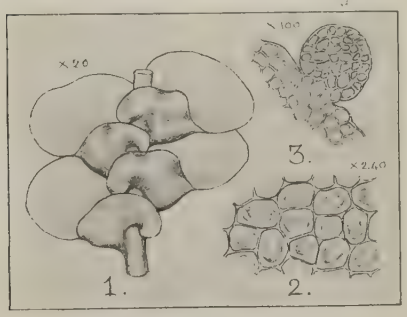
The postical lobe hardly does more than cross the inside margin of the stem, though attached to it for a greater distance than in the other species; the upper angle is rounded and lies nearer the stem than in either *R. aquilegia* or *R. Carringtonii*.

The perianth is not terete; it is nearly so in the lower third or half which corresponds to the neck, above this it is distinctly compressed, and at the mouth is almost complanate. The perianth appears as if lateral on account of an innovation being immediately beneath the bracts. The capsule is cylindrical and the spores are smaller than in the other species.

239. Radula voluta Tayl.

Radula voluta Tayl. in G. L. N., Syn. Hep. p. 255 (1844); Jack in Flora No. 25 (1881); Pears., Hep. Brit. Isles p. 67 (1899).

Radula xalapensis Lindb. *non* Mont., Hep. in Hib. lect. p. 491 (1875); Moore, Proc. Roy. Irish Acad. p. 616 (1877).



1. Stem with leaves. 2. Cells. 3. Gemma.

Dioicous. In small and shallow pale green *or pale yellow-green* patches, or as scattered stems creeping over mosses. Stems 1·5–3·5 cm long, flexuose, green or brownish-green, prostrate, irregularly pinnately and frequently bipinnately branched, sometimes decompound, the branches rather numerous, generally short, patent or ascending. Leaves distant below, approximate to subimbricate above, horizontal but not

decurved, the antical lobe subovate-rotundate, broader than long, crossing the stem, *flaccid* and slightly undulate, the margin not inflexed, postical lobe *3 times* smaller, *large*, *subcordate-rotundate*, *widely crossing the stem*, inflated at the base, *undulate above*, inflexed only in the younger branches, the apex of lobe rounded or sometimes with a point; cells 16–22 μ, roundish-polygonal, opaque, the walls thin, trigones minute; cuticle nearly smooth. ♀ inflorescence, "on the sides of the stems" (Gottsche). Androecium on a short spike occupying the whole or the apex of a lateral branch, occasionally intercalary on the stem, bracts in 3–4 pairs, smaller than the leaves, suberect, imbricate, nearly equally bilobed, ventricose but not pendulous at base. Gemmae large, discoid, multicellular, on the margin of the upper leaves, scarce.

HAB. Creeping among mosses in moist or wet shady ravines.

DISTRIB. Wales to Ayrshire, very rare; West of Ireland.

Might be mistaken in the field for *R. complanata*, as the colour is nearly the same though rather paler, but the less imbricate leaves, the more flexuous stems, which are generally only scattered or in thin layers over mosses, and the absence of perianths will assist in distinguishing it; it does not appear to occur on trees, and rarely directly on the rock as the other does. With the lens the large rotundate postical lobe crossing the stem will readily distinguish it from any of our species. In colour it is quite unlike the other atlantic species of the genus; the female plant of *R. Lindbergii* occurs on the low ground, but it is of a dull green colour and usually gemmiferous, and resembles *R. complanata* except in its inflorescence.

The postical lobe is distinctly inflated at the base, and the upper margin is often reflexed and with a point; it does not generally cross the stem on the branches; it may lie partly on the stem and partly on the antical lobe though not usually on the latter; the undulation of this lobe is marked.

The oil-bodies in the leaf cells are sometimes very distinct. Gemmae are scarce but are occasionally well developed. The male plant is common; I have not seen the female.

SUBFAMILY **Pleurozioideae**

Plants usually *large*, pale or brown, *very often purple*, with erect stems from a rhizomatous base, branches lateral. Leaves incubous, rarely undivided, nearly always 2-lobed, the antical lobe entire or dentate, the postical lobe smaller, *saccate*, with its base on the postical side of the stem and attached to the lower part of the antical lobe, *its narrow mouth often closed by a complicated valve apparatus*. Underleaves absent. ♀ and ♂ inflorescence on short lateral branches. Perianth *elongate and narrow*, generally 4–10-plicate from the middle, the mouth contracted, ciliate-dentate. Capsule

oval, 4-valved to the base. Elaters deciduous, bispiral. "Sterile perianths" on short branches, cylindrical, smooth, the mouth wide, circular, entire, the margin incurved. Androecia small, spicate, bracts 6–12 pairs, imbricate, monandrous.

LXII. PLEUROZIA Dum.

Pleurozia Dum., Rec. d'obs. p. 15 (1835).
Physiotium Nees, Eur. Leb. III p. 75 (1838).

Characters of the subfamily.

The structures called by Nees "sterile perianths," ("tubi vacui," Stephani in *Spec. Hepat.*) which are not found in any other genus, are smooth, subcylindrical tubes, arising from the end of short branches as in the case of the ordinary perianth, and with similar involucral leaves.

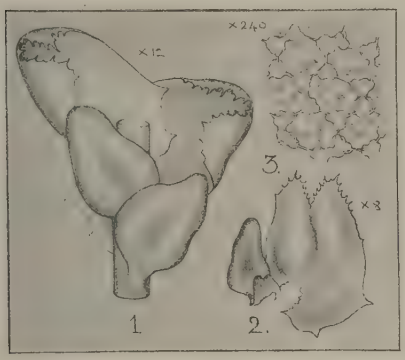
All the species of this genus, with one exception, have the leaves bilobed. The postical lobe forms a water-sac, which is closed except at a small aperture lying in a depression on its antical side. The aperture is bounded by two portions of the wall which act as a valve, one side being fixed, the other moveable. The valve can only open inwards, so that the water contained inside cannot escape until it evaporates after absorption by the walls of the sac; when the plant becomes dry, the walls of the valves, being composed of delicate cells, shrivel and allow the free entrance of water; this causes the cells again to expand and closes the opening. Rotifers and other animals can enter, but whether the absorption of their products of decomposition with the water into the plant has any effect on it is not known. Goebel gives further particulars on this subject in his *Organography of Plants*.

240. Pleurozia purpurea (Lightf.) Lindb.

Jungermannia purpurea Lightf., Fl. Scot. p. 778 (1777).
Jungermannia cochleariformis Hook., Brit. Jung. *pl.* 68 (1814).
Pleurozia cochleariformis Dum., Syll. Jung. p. 38 (1831).
Physiotium cochleariforme Nees, Eur. Leb. III p. 79 (1838).
Pleurozia purpurea Lindb., Musc. Scand. p. 3 (1879).

Monoicous. In *tall and rather loose purple to reddish-yellow tufts.* Stems 5–16 cm long, flexuous, sub-arcuate, decurved at the apex, black below, brown above, denudate at base, closely leaved elsewhere, suberect or decumbent, simple or with 1–3 short suberect innovations generally from the upper part of the stem; *rhizoids absent* except in the rhizomatous base. Leaves closely imbricate, concealing the stem, *postically secund*, incubous, *complicate-bilobed*, *the antical lobe large*, patent, *convex*, *rotundate-ovate*, emarginate at the apex, segments triangular, acute or subacute, *incurved* and somewhat

connivent, the antical margin of lobe broadly rounded, widely crossing the stem, decurrent, with frequently 1–2 spinous teeth above the base, the postical margin slightly curved, both margins towards the apex, together with the segments, *spinous - dentate ;* postical lobe 3–4 times smaller than the antical lobe and attached to it for a short distance at the base, the lower part *incumbent on the postical side of the stem* which it crosses, erecto-patent and nearly parallel to the stem, *ovate*, narrowed at the base, *inflated and saccate*, *hooded at the apex*, the antical side with a longitudinal fold and slit and with two appendages within the sac; cells 22–30 μ, oblong, *nodulose and stellate*, the walls thick, *trigones very large and frequently confluent*, reddish-yellow to purple, cells near apex rounded or rounded-oblong, not or sometimes slightly stellate, the trigones smaller, cells at base linear-oblong, more or less nodular, trigones very large; cuticle verruculose. ♀ inflorescence on a short branch from near the apex of the stem, with a strong, sterile innovation. Involucral bracts with the antical lobe narrower than that of the leaves, the postical lobe of one bract resembling the antical lobe in form and size and spinous-dentate at the apex but less deeply bilobed, not saccate, in the other bract absent and in its place two free paraphyllia-like leaves. Perianth (not fully developed) oblong-ovate, with three obtuse and swollen folds extending to below the middle, the mouth suddenly contracted, divided into about 12 small triangular lobes, each with 2–3 short cilia on the margin and with the apex ending in a cilium of 6–8 uniseriate thickened cells, the surface of the lobes also with some spinous cells. ♂ branches short, near the ♀ ; bracts in 6–10 pairs, densely imbricate, broadly ovate-rotundate, complicate-concave, the apex sometimes almost entire or more frequently 3–4-lobed for $\frac{1}{4}$–$\frac{1}{3}$, the lobes lanceolate, incurved, obtuse or acute. Antheridia oval to oval-globose, solitary.



1. Stem (postical view). 2. Leaf. 3. Cells.

HAB. On wet moors, and moist rock ledges on the hills.

DISTRIB. Kircudbright to Orkney, common in the west and north Highlands, rare elsewhere; Ireland.

This large and handsome species does not bear any resemblance to our other hepatics. When on peat-mosses and moors it is smaller and darker coloured than when on moist rock ledges, or among boulders, on the hills. Some of the older botanists confused it with *Scapania dentata*, but that is hardly likely to be done at the present time.

Both lobes are nearly parallel to the stem. The large convex antical lobe lies in front of, and crosses it, while the saccate postical lobe is on the other side; the upper margin of the antical lobe is usually spinous-dentate for $\frac{1}{4}$–$\frac{1}{3}$ of its length, the lower margin for a shorter distance.

Kaalaas in *De Dist. Hep. in Norv.* p. 123 describes the "sterile perianths" of Norwegian specimens as 1–3 mm long and to 2 mm broad, obovate or sub-cyclindrical, later obconical, the margin of the mouth inflexed and minutely dentate, at length irregularly lobate with the lobes inflexed.

P. purpurea, which is confined in Europe to the north-west, has been recorded also from the Himalayas and the Hawaiian Islands.

The description of the ♀ inflorescence is taken from Schiffner in *Oest. bot. Zeit.* p. 4, 1912. He mentions that mature perianths may be more longly pointed at the apex and with several plicae as in *P. gigantea*. The description of the ♂ inflorescence is taken from Kaalaas in *De Dist. Hep. Norv.* p. 123, 1893

Subfamily **Madothecoideae**

Dioicous. Plants large, green or brown. Stems arising from a rhizomatous base, usually *regularly bi- or tri-pinnate*, the branches lateral; rhizoids scarce, arising from the base of the underleaves. Leaves incubous, *complicate-bipartite almost to the base*, the antical lobe large, sub-ovate, entire or dentate, *postical lobe much smaller, ligulate, linear or ovate*, nearly parallel to the stem and frequently decurrent at the external base. *Underleaves everywhere present, resembling the postical leaf-lobe, but broader*, frequently decurrent at the base on both sides. ♀ *inflorescence terminal on very short lateral branches;* bracts usually a single pair, almost always dentate or ciliate. Perianth sub-oval, somewhat frontally compressed, trigonous in section, the mouth *becoming bilabiate or campanulate* by the extrusion of the capsule. Calyptra of several layers of cells. Capsule shortly pedicellate, globose, 4-valved, the valves often irregularly slit and *rarely separating down to the base*. Elaters short, 2–3-spiral. Androecia shortly spicate, terminal on short lateral branches, bracts nearly equally bilobed, exactly opposite and connate with the underleaves; antheridium almost constantly solitary.

Madotheceae Dum.; *Bellincinioideae* Schiffn.

LXIII. MADOTHECA Dum.

Porella Dill., Hist. Musc. p. 459 (1741) ? ; Lindb. in Act. Soc. Sc. Fenn. p. 329 (1869).
Bellincinia et *Antoiria* Raddi in Mem. Soc. Ital. Mod. 18 pp. 18, 19 (1820).
Madotheca Dum., Comm. Bot. p. 111 (1822).

Characters of the subfamily.

1 { Underleaves dentate or ciliate-dentate; antical lobe of leaf usually acute; plant acrid ..... *241. laevigata*
{ Underleaves entire (unless at extreme base); antical lobe obtuse; not acrid 2

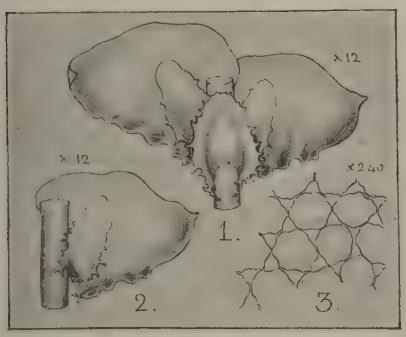
2 { Postical lobe longly decurrent, with its outer margin broadly reflexed ..... *244. rivularis*
{ Postical lobe scarcely or not decurrent, with both margins lightly or not reflexed 3

3 { Leaves not or scarcely imbricated; postical lobe minute, lingulate-oblong; underleaves flat ..... *245. Porella*
{ Leaves closely imbricated; postical lobe larger; underleaves with reflexed margins 4

4 { Antical lobe obliquely ovate; postical lobe usually about half the breadth of the underleaves ..... *243. platyphylla*
{ Antical lobe rotundate; postical lobe nearly as broad as the underleaves ..... *242. Thuja*

241. Madotheca laevigata (Schrad.) Dum.

Jungermannia laevigata Schrad., Syst. Samml. Crypt. Gew. 2 p. 6 (1797).
Madotheca laevigata Dum., Comm. Bot. p. 111 (1822).
Porella laevigata Lindb., Musc. Scand. p. 3 (1879).



1. Leaves and underleaf on stem.
2. Leaf. 3. Cells.

Dioicous. In large *loose, shining* yellow-green to dark green, rarely olive-brown patches, *acrid*. Stems 6–10 cm long or occasionally longer, reddish-brown, procumbent, irregularly pinnate and more or less bipinnate, branches horizontal to patent, usually of equal breadth throughout, sometimes and especially towards the lower part of the stem attenuate and decurved; rhizoids from the base of the underleaves, scarce,

brownish. Leaves closely imbricate, appressed, the antical lobe patent, *not or hardly crossing the stem*, convex, *obliquely semi-cordate-ovate*, narrowed towards the apex which is generally *acute to mucronate*, more rarely obtuse or dentate, the upper margin broadly rounded, entire, repand, frequently with a tooth near the base, the lower margin less arched, *undulate-crispate above the base*, frequently with one or more teeth, seldom with both margins dentate near the apex; postical lobe about as long as, or longer than the underleaves, narrowly *oblong*, narrowed at the pointed, sub-acute or obtuse apex, *not decurrent*, *the margin usually flat*, *spinous-ciliate* to dentate, rarely entire. Underleaves approximate, slightly wider than the stem, *narrowly ovate-quadrate*, somewhat narrowed at the truncate or rounded apex, longly decurrent, nearly flat, the *margin spinous-ciliate* to dentate, rarely entire; cells 23–28 μ, rounded polygonal, the walls slightly thickened, trigones large, cells near the margin smaller, subquadrate, with thickened walls; cuticle smooth. ♀ inflorescence on short branches proceeding from the main stem or branches, either with or without 1–3 leaves; involucral bracts resembling the leaves but rather larger and generally ciliate, bracteole broadly oval, ciliate or sub-entire. Perianth broadly obovate, mouth wide, truncate, ciliolate. Androecium ?

var. **killarniensis** Pears., Journ. Bot. p. 81 *pl.* 477 (1906).

Very large in loose tufts, *pale yellowish-green* above, *ochraceous* below. Stems to 12 cm long, irregularly bipinnate. Antical lobe with the *apex acuminate and the upper third of both margins spinulose-dentate;* postical lobe and underleaves strongly spinous-ciliate and dentate; involucral bracts spinous-ciliate.

var. **obscura** Nees, Eur. Leb. III p. 166 (1838).

Dull green. Antical lobe of leaf *apiculate or obtuse*, rarely with a few obtuse teeth on the margin near the apex; postical lobe spinulose-dentate to subentire; *underleaves subentire* to remotely dentate or spinulose-dentate; cells opaque, *trigones small.*

var. **Thuja** Nees, Eur. Leb. III p. 166, excl. syn. (1838).

Madotheca canariensis Nees, Eur. Leb. III p. 207 (1838) ?

Antical lobe of leaf cordate-ovate, the *apex rounded-obtuse to subacute*, with a few leaves occasionally *apiculate*, especially near the apex of the stem; postical lobe oblong, narrower than the underleaves, the apex rounded-obtuse to subacute, seldom apiculate, the

margins sinuate, *entire* or sometimes with a few obtuse teeth ; underleaves oblong-ovate, the margins reflexed, sinuate, *entire*.

HAB. On rocks and about the roots and stems of trees in moist shady places.

DISTRIB. N. to Ross, widely distributed but uncommon ; Ireland. Var. *killarniensis*, Killarney, 1885 (*Steward and Holt*), 1905 (*W. H. Pearson*).

This is the only one of our species which has a peppery taste. It can also generally be distinguished from the others by its acute antical lobe and by some at least of the postical lobes and underleaves being spinous-ciliate, but forms occur with the apex rounded and with the postical lobe and underleaves nearly entire. In the common forms of the plant the postical lobe will always be found to be more or less spinous-ciliate near the apex of some of the stems, and this by itself will distinguish it from the other species. The postical lobe is typically oblong-ligulate and flat ; it is however, not unfrequently revolute, especially near the apex of the stem and branches.

The leaves on the branches bearing the ♀ inflorescence are often limited to a single pair, which may be small, nearly equally and acutely bilobed ; the branch is longer than in the other species, except perhaps in *M. Thuja*.

Var. *killarniensis* is a large, loosely tufted, graceful, pale green form, ochraceous in the lower part. The armature of the leaves varies a good deal, but there are usually several spinous-ciliate teeth on the margins, the postical lobes and underleaves are always spinous-ciliate.

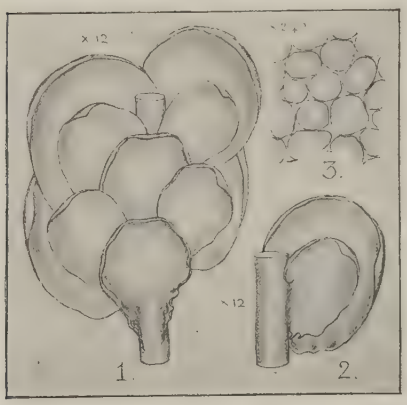
Var. *Thuja* differs from *M. Thuja* in the antical lobe being longer, narrowed towards the apex which is occasionally apiculate or subacute, and the postical lobe narrower, and in having the peppery taste, though this may not always be present if the plant has been kept for a long time in the herbarium. It is doubtful at present if this plant is permanently distinct from *M. canariensis* Nees. Schiffner gives notes on the subject in his "Neue Mater. z. Kennt. d. Bryoph. Atlant. Inseln." (Hedwigia p. 275, 1902). Mitten mentions in a manuscript note that Hooker's specimens which were gathered by Miss Hutchins "upon stones at the side of Gougan Barra Lake near Bantry," called *Jung. platyphylla*. var. *major*, "Brit. Jung." No. 40 are *Mad. canariensis* ; also that the same plant has been found on the Lizard, Cornwall.

242. Madotheca Thuja (Dicks.) Dum.

Jungermannia Thuja Dicks., Plant. Crypt. Fasc. 4 p. 19 (1801).
Madotheca Thuja Dum., Comm. Bot. p. 111 (1822).
Porella Thuja Moore p.p., Proc. Roy. Irish Acad. p. 618 (1877).

Dioicous. In *compact*, *shining* olive-brown to dark green patches, *not acrid*, generally larger than *M. laevigata*. Stems 3–5 cm, seldom to 8 cm long, reddish-brown, procumbent, irregularly pinnate and frequently bipinnate, *branches short*, horizontal to patent, usually of equal breadth throughout and *obtuse*, sometimes attenuate and frequently rooting at the end ; rhizoids rather numerous, less commonly scarce, brown. Leaves *densely* imbricate, appressed, the antical lobe patent, *distinctly* crossing the stem, strongly convex and *decurved*, obliquely *rotundate*-cordate, the apex *rotundate*, the

upper margin very strongly arched near the base and *reflexed in the lower half*, repand, frequently slightly dentate above the base, the lower margin less strongly arched, undulate-crispate *at the base* and with occasionally 1–3 teeth in the lower half, both margins otherwise entire; postical lobe *nearly as broad as the underleaves, broadly oval-oblong, rounded at the apex*, not decurrent, the margin slightly incurved, *entire*. Underleaves *imbricate*, much wider than the stem, *rotundate-oblong* or sub-cordate-oblong, decurrent, the margin and apex slightly reflexed, *entire*, the base undulate-crispate; cells 18–28 μ, rounded-polygonal, the walls slightly thickened, trigones large, cells near the margin rather smaller, oblong to subquadrate with thickened walls; cuticle smooth. ♀ inflorescence on a branch bearing 1–2 pairs of leaves; involucral bracts and bracteoles nearly resembling the leaves but with the margins dentate-ciliate, the antical lobe obliquely ovate, narrowed towards the apex, margin of bracteole ciliate.



1. Leaves and underleaves on stem.
2. Leaf. 3. Cells.

HAB. On exposed rocks on the coast, seldom inland.

DISTRIB. Cornwall to the Outer Hebrides and Kincardine, rare.

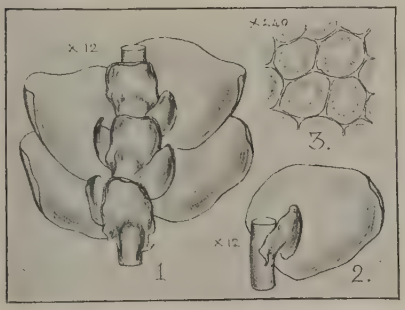
This rather rare Atlantic and Mediterranean species can be distinguished from all our forms of *M. laevigata* by the suborbicular antical lobe and by the absence of a biting taste. The postical lobe is also broader, being nearly as broad as the underleaf; the antical lobes are more closely imbricate and more decurrent.

243. Madotheca platyphylla (L.) Dum.

Jungermannia platyphylla L., Sp. Pl. p. 1134 p.p. (1753).
Madotheca platyphylla Dum., Comm. Bot. p. 111 (1822).
Porella platyphylla Lindb., Musc. Scand. p. 3 (1879).

Dioïcous. In rather compact and generally flat *dull, yellow-green*, less frequently dull-green patches. Stems 3–8 cm long, rigid, brown, paler above, prostrate or procumbent, irregularly 2–3-pinnate,

branches patent to ascending; rhizoids scarce. Leaves closely imbricate, the antical lobe patent, crossing the stem, slightly convex, obliquely broadly ovate to rotund-ovate, the apex broadly rounded, the margins entire, sometimes repand, the more strongly arched upper margin occasionally with a tooth above the base; postical lobe about half as broad as the underleaves, oblong-ovate, obtuse or subacute at the apex, *not or hardly decurrent*, the margin slightly and narrowly recurved, entire, the base frequently sinuate and with a tooth. *Underleaves imbricate*, rotund-quadrate, longly decurrent, the apex somewhat narrowed and rounded or nearly truncate, the margin entire, narrowly recurved, more or less sinuate and occasionally with a tooth at the base; cells 20–30 μ, rounded-polygonal, the walls thin, trigones small, marginal cells subquadrate with hardly thickened walls; cuticle nearly smooth. ♀ inflorescence on a very short branch usually without leaves; involucral bracts smaller than the leaves, the antical lobe usually obtuse, the postical usually acute, both lobes entire or dentate. Perianth oval, convex on both sides in the lower half, compressed above, the mouth slightly narrowed, bilabiate, *denticulate or ciliolate*. Capsule globose, very shortly pedicellate, the wall of three layers of cells, the inner wall without thickenings. Spores 36–45 μ, yellow-brown, finely echinate-papillose; elaters 2–3-spiral, brown. Androecia in short oblong-oval spikes, bracts in few pairs, closely imbricate, ventricose, nearly equally bilobed, lobes obtuse.



1. Leaves and underleaves on stem. 2. Leaf. 3. Cells.

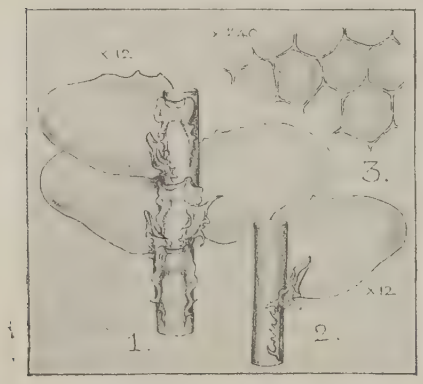
HAB. On rocks, walls and about the roots of trees, usually in rather shaded places.

DISTRIB. N. to Elgin, frequent in limestone districts but not confined to them; Ireland.

Differs from *M. Thuja* in its usually smaller size, the dull yellowish green colour, antical lobes narrower, less closely imbricate and less decurved, not cordate at base and with the upper margins not reflexed, the postical lobe only about half as broad as the underleaves, leaf-cells rather smaller and with thinner walls, especially the marginal row, and the trigones smaller, the involucral bracts and bracteole entire or dentate, not ciliate. It is not likely to be confused with that species, but it is sometimes not readily distinguished from *M. rivularis*.

244. Madotheca rivularis Nees

Madotheca rivularis Nees, Eur. Leb. III p. 196 (1838).
Porella dentata Lindb., Act. Soc. Sc. Fenn. p. 342 (1869).
Porella rivularis Trevis., Mem. Ist. Lomb. III 4 p. 407 (1877); Lindb., Musc. Scand. p. 3 (1879).



1. Leaves and underleaves on stem.
2. Leaf. 3. Cells.

Dioicous. In generally rather loose and flat, dull dark green, less frequently yellow-green patches. Stems 3–8 cm long, pale brown, prostrate or procumbent, irregularly pinnate or bipinnate, branches rather long and ascending, obtuse; rhizoids scarce. Leaves *approximate or imbricate*, the antical lobe patent, crossing the stem, flat or nearly so with the apex slightly decurved, obliquely broadly ovate, the apex rounded, the margin entire, sometimes repand, the slightly more strongly arched upper margin frequently subdenticulate above the base; *postical lobe small*, less than half as broad as the underleaves, obliquely ovate to narrowly triangular, *acute*, *longly decurrent*, the margins, especially the outer, broadly recurved, undulate entire, the base sinuate, usually with one or more teeth. *Underleaves distant*, seldom imbricate, *oval-quadrate*, *very longly decurrent*, the apex rounded, the margin entire, repand, flat or slightly recurved, the base more or less dentate; cells 25–35 μ, *rounded*-polygonal, the walls thin, *trigones minute*, cells near the margin only slightly smaller and hardly different. ♀ inflorescence on a very short branch without leaves; inner involucral bracts much smaller than the leaves and nearly equally bilobed, the antical lobe of outer bract acute, the margin repand, lower half subdenticulate and occasionally slightly ciliolate, the postical lobe obtuse or subobtuse, repand, frequently with a tooth at base. Perianth broadly oval, compressed, *the mouth small*, bilabiate, *repand-lobate*, *entire*. Capsule globose, very shortly pedicellate, the wall of three layers of cells, the inner wall without thickenings. Spores 35–49 μ, yellow-green, smooth; elaters 2–3-spiral, brown. Androecia in short oblong-oval spikes, bracts in 2–4 pairs, closely imbricate, ventricose.

var. **simplicior** (Zett.) K. Müll., Bot. Centralb. p. 103 (1902).

Madotheca simplicior Zett., Oversigt. of Kongl. Vet. Akad. Handl. 2 p. 53 (1877).
Porella rivularis β simplicior Lindb., Musc. Scand. p. 3 (1879).
Madotheca Levieri Jack et Steph., Flora 30–32 p. 496 (1888).

Larger than the type. Olive-green, frequently becoming yellowish-green and *somewhat shiny* when dry. Stems elongate, *branches* few, *irregular*, frequently *long and simple*, external cells of stem in 2–4 rows, *greatly thickened* and reddish; underleaves with a large, decurrent base, sinuate-lobate or with a tooth.

var. **faeroensis** C. Jens. in Bot. of the Faeroes 1, Bryophyta p. 124 (1901).

In compact dark green to yellowish-brown tufts. Stem short, 2–3 cm long, thick, densely leaved, irregularly pinnate and partly bipinnate, the branches patent to ascending, obtuse; postical lobe almost half as broad as the underleaves, triangular-ovate, *obtuse* or *subacute*, seldom acute, entire at the base or occasionally with a tooth.

Hab. On moist shaded rocks and about the roots of trees.

Distrib. Wales to Caithness, ascending to 3200 ft. alt. in the Highlands, more frequent than the preceding, at least in the north, but uncommon in the western part of the Highlands; Ireland. Var. *faeroensis*, Sandwater Loch, Bister, Shetland, 1902 (*S. Grieve*).

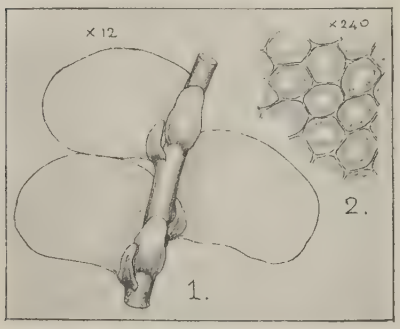
Is a very variable plant, but cannot very well be mistaken for any of the others except *M. platyphylla*. In most cases there is little difficulty in distinguishing it from that species by the smaller postical lobe which is longly decurrent and frequently twisted on account of the strongly revolute outer margin; also by the distant and very longly decurrent underleaves, the decurrent part being sometimes as long as the free portion; the underleaves are, however, not rarely approximate or even to some extent imbricate. The perianths are different in the two species, the present plant having a small mouth which is not denticulate and ciliate.

The postical lobe of *M. rivularis* is subject to much variation and is occasionally almost as small as in *M. Porella*. It is usually wider than in the specimen drawn in the figure. The var. *simplicior* has more the habit of *M. laevigata* and is sometimes shiny as in that species. The var. *faeroensis* is unlike the typical plant in its dense, compact, partly brownish tufts. It was originally described by Jensen from the Faróe Islands, and has only been otherwise recorded from Shetland.

245. Madotheca Porella (Dicks.) Nees

Jungermannia Porella Dicks., Trans. Linn. Soc. p. 239 (1797).
Jungermannia distans Schwein., Spec. Fl. Am. Sept. Crypt. p. 9 (1821).

Madotheca Porella Nees, Eur. Leb. III p. 201 (1838).
Madotheca involuta Hampe in Lehm. Pug. 7 p. 10 (1838).
Porella pinnata Lindb., Hep. in Hib. lect. p. 493 (1875).



1. Leaves and underleaves on stem.
2. Cells.

Dioicous. In flat, loose, entangled, *dark olive-green* patches, *usually submerged*. Stems 3–8 cm long, rigid, flexuose, black and denudate below, procumbent, *2 – 3 - pinnate*, branches divergent, obtuse. Leaves *distant to approximate* or slightly imbricate, the antical lobe horizontal, *not crossing the stem*, flat or slightly convex, *oblong-oval*, the apex rounded, the upper margin broadly arched and flat, the postical margin less arched and usually *slightly incurved*, *both margins entire* ; *postical lobe minute*, with its inner margin appressed to the stem, *lingulate-oblong to linear-oblong*, obtuse, *not decurrent*, *flat* or slightly concave, the margins entire, *the base not sinuate or dentate*. Underleaves *longly distant*, oblong-*quadrate*, *hardly decurrent*, *appressed* to the stem, the apex rounded or truncate, the margins *flat* or slightly concave ventrally, *entire* ; cells *16–25* μ, polygonal, the walls thin, trigones minute. Involucral bracts entire or nearly so. "Perianth obovate-pyriform, 4–5 times the length of the bracts, slightly crenulate at the mouth ; spores 30–42 μ, papillate, elaters 2–4-spiral." (*Howe*). Androecium ?

Hab. On wet rocks in streams, frequently submerged.

Distrib. Devon ; Wales ; south-west of Ireland ; very rare.

This species has the habit of a *Fontinalis*, being attached by its base to the rocks, and floating in the water. It has a certain resemblance in the field to some forms of *Chiloscyphus*, but will not probably be overlooked on this account.

M. Porella more resembles *M. rivularis* than it does the other species, but its recognition does not afford any difficulty ; the points italized will enable the student to identify it. The minute postical lobe has its inner margin appressed to the stem.

Subfamily Jubuloideae

All branches lateral. Leaves alternate, *incubous, complicate-bilobed, the postical lobe (lobule) smaller, usually inflated or saccate.* Underleaves nearly always present with rhizoids in clusters from close to their base. ♀ *inflorescence monogynous or 1–4-gynous*, very rarely more, terminal on the main stem or principal branch or sometimes on a short special branch. Perianth free, more or less frontally compressed, 2–12 angled, rarely terete, *the apex constricted into a short tubular mouth.* Calyptra free. Capsule on a short pedicel, globose, 4-valved for $\frac{2}{3}$ *of its length, the lower third solid. Elaters few, monospiral, attached to the inside of the capsule-wall by their upper ends and extending to the floor of the capsule, their lower ends trumpet-shaped and becoming free.*

Spruce states in *Hep. Amaz. et And.* that it seems more correct to consider the solid lower part of the capsule, that is, the lower third or so, to be the dilated apex of the pedicel, on the circumference of which are placed the four valves. These valves are usually composed of two layers of cells which have irregular thickenings on the inner face instead of the usual semi-annular bands. When the capsule bursts, the elaters remain attached to the valves by their narrow ends, the less firmly attached truncate ends becoming free. The elaters are always monospiral. Spruce gives much information on the *Jubuloideae* in the above mentioned work. He considers the group of such importance that he divides the whole of the *Jungermanniaceae* into *Jungermannieae* on the one one hand and *Jubuleae* on the other, and has been followed in this by most English authors, and, so far as the *Jungermanniaceae acrogynae* are concerned, by Müller in *Rabh. Krypt. Fl.*, now in course of publication.

Tribe Lejeuneeae.

Plants large to very small, most commonly green, very rarely reddish. Branches contiguous to the *outer base* of the leaves, i.e., infra-axillary. Innovations usually present, adnate to the ♀ bracts. Postical lobe *inflated and incurved*, rarely flat, sometimes obsolete, nearly always *attached to the antical lobe by a broad fold and to the stem.* ♀ inflorescence monogynous. Pedicel of capsule short, cruciate in section, articulate when dry.

A branch in this tribe does not arise from the whole of the postical half of a segment, so that the postical lobe of the leaf below which it arises is present. There are however exceptions in a few exotic genera. The innovations arise from immediately beneath the bracts to which they are adnate; they may bear perianths and again become innovant, and this sometimes goes on repeatedly. If there be only one innovation, it may look like a continuation of the stem, and the perianth appear as if lateral. The position of the leaves will at once show whether the perianth is on a short lateral branch or on an innovation, as in the former case the first leaf of the main stem will be on the side next the perianth, while in the latter it will be on the side away from the perianth.

The pedicel consists in section of four large cells besides small cortical ones, arranged in two concentric circles. When the outer walls become attenuated in

the process of the lengthening of the pedicel and collapse, each tier of the four large cells forms an "articulation," which becomes specially evident when dry. It has sometimes been considered unadvisable to treat Spruce's subgenera of *Lejeunea* as genera when dealing with a limited area, as several in this case are monotypic; but they are almost always now treated as genera when dealing with a large surface of the globe, and to treat them as subgenera in a local flora would mean giving most of the species two names, which is inadmissible. Spruce did not consider the matter to be of great importance, but in view of the possibility of his subgenera being treated as genera, he retained the name *Lejeunea* in them all, and prefixed some characteristic term, so that the relationship would be evident.

In consideration of the close connection between the genera of *Lejeuneeae*, an additional key is subjoined, showing their relation to each other.

1 { Underleaves absent ..... *LXV. Cololejeunea*
  { Underleaves present 2

2 { Underleaves undivided ..... *LXX. Marchesinia*
  { Underleaves bilobed 3

3 { Underleaves doubled, one to each side leaf, leaves saccate and beaked *LXIV. Colurolejeunea*
  { Underleaves single, one to each pair of side leaves, leaves not saccate 4

4 { Underleaves with divergent lobes 5
  { Underleaves with lobes more or less incurved 6

5 { Underleaves deeply divided, lobes acute ..... *LXVIII. Drepanolejeunea*
  { Underleaves only emarginate, lobes very obtuse ..... *LXIX. Harpalejeunea*

6 { Lobes of leaf nearly equal in size ..... *LXVII. Microlejeunea*
  { Antical lobe much larger than postical lobe ..... *LXVI. Lejeunea*

LXIV. COLUROLEJEUNEA (Spruce) Schiffn.

Colura Dum., Rec. d'obs. p. 12 (1835).
Lejeunea subgen. *Coluro-Lejeunea* Spruce, Hep. Amaz. et And. p. 303 (1884).
Colurolejeunea Schiffn. in Engl. and Prantl, Nat. Pflanz. I 3 p. 121 (1895).

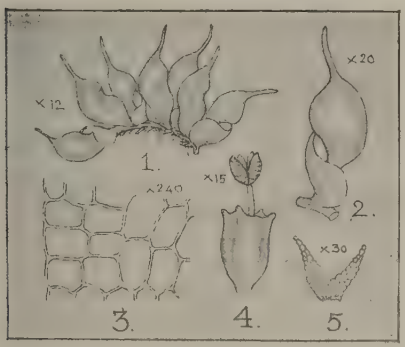
Plants small. Leaves attached by a very narrow base and *ending in a variously shaped sac* derived from the antical lobe, and frequently closed by a valvular arrangement; postical lobe with the margin *strongly involute*. *Underleaves doubled*, i.e., one to each side leaf, deeply bifid, usually with subulate lobes. Perianth variable. Androecium small, occupying a short lateral branch.

The postical lobe becomes concrescent with the antical lobe and is inrolled against it, forming a canal leading into the sac. The entrance to the sac is closed by a valve which can only open inwards.

The double number of underleaves occurs in no other genus of foliose hepatics except *Diplasiolejeunea*.

246. Colurolejeunea calyptrifolia (Hook.) Schiffn.

Jungermannia calyptrifolia Hook., Brit. Jung. *pl.* 43 (1813).
Lejeunea calyptrifolia Dum., Comm. Bot. p. 111 (1822).
Colura calyptrifolia Dum., Rec. d'obs. p. 12 (1835).
Colurolejeunea calyptrifolia Schiffn. in Engl. and Prantl I 3 p. 121 (1895).



1. Plant. 2. Leaf. 3. Cells. 4. Perianth. 5. Underleaf.

Monoicous. *Minute.* In small *pale green* patches. Stems 2–4 mm long, filiform, tender, prostrate, sparingly branched, the branches somewhat ascending; rhizoids scarce, colourless. Leaves distant at their narrow base, *ovoid and crowded above, erect* or ascending, suddenly narrowed into a *long straight or slightly curved beak* about one-third the length of the whole leaf, near the base of the antical lobe with a *free, oval, incurved, portion;* postical lobe small, *strongly involute,* forming a canal leading into the beak; the sac inflated except in the beak; cells 20–35 μ, 4–7-angled, greatly variable in size and shape, convex, thin-walled, the angles not or very slightly thickened; cuticle smooth. Underleaves distant, patent, *deeply bifid* with subulate lobes. ♀ inflorescence on a principal branch. Involucral bracts small, strongly concave, oblong-quadrate, the apex entire or slightly emarginate. Perianth longly exserted beyond the bracts but not beyond the leaves, oblong with a narrow base, *truncate at the apex,* with five obtuse angles on the upper part ending in papillose, *spreading horns,* the mouth small, beak very short, 1-celled. Capsule globose. Spores 40–65 μ, long and 21–30 μ broad, angular-oblong, finely verruculose, pale brown. Androecium occupying a lateral branch, small, globose, bracts in 3–5 pairs, strongly concave, emarginate; antheridia in pairs, broadly oval, brown. Gemmae discoid, on the surface of the leaf, especially on the beak.

Hab. Rocks and trees in moist shaded localities near the west coast.

Distrib. Cornwall to West Ross-shire, very rare; Ireland. Fr. April–June.

Although a minute plant it is easily recognised in the field by the small, isolated, pale green patches on the dark background of wet rocks. It is most

commonly found on thin patches of *Frullania Tamarisci* on the rock, the *Frullania* being very dark coloured in wet habitats. It is more conspicuous when on stems of trees, being then in rather larger patches, but it is rare in that position. With a lens it cannot be mistaken, being quite unlike our other hepatics.

The leaves are erect or ascending and do not lie on the substratum as do nearly all the other small *Lejeuneae*. When the leaf is not fully developed, the beak is longer in proportion to the whole leaf; it is rather less than a third the length of the leaf in well developed specimens. The cells project more or less, and give a broadly papillose appearance to the leaf, especially on the beak, but this varies greatly. The papillosity of the horns of the perianth is also due to this convexity of the cells. These horns vary considerably in length.

LXV. COLOLEJEUNEA (Spruce) Schiffn.

Lejeunea subgen. *Colo-Lejeunea* Spruce, Hep. Amaz. et And. p. 291 (1884).
Cololejeunea Schiffn. in Engl. and Prantl Nat. Pflanz. I 3 p. 121 (1895).

Plants small and tender. Leaves attached by a very narrow base, the antical lobe rounded or subacute at the apex, the margin entire, crenulate or denticulate. *Stylus present* at the junction of the postical lobe and the stem, composed usually of a single series of cells, or leaf-like, sometimes reduced to one cell which early disappears. *Underleaves absent* on the stem and on the ♀ inflorescence; in their place clusters of rhizoids. ♀ branch innovating on one side, the innovations often floriferous.

The absence of underleaves readily distinguishes this genus. The stylus is always present, but frequently it is minute and early becomes absorbed. It is derived from the leaf, not from the underleaf as thought by Spruce, and, as Evans remarks, may be considered as homologous with the stylus of *Frullania*.

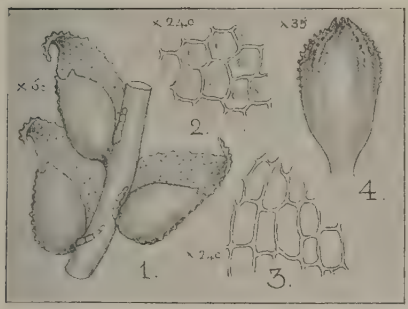
1 { Antical lobe much larger than postical lobe, rough from projecting cells ...2
  { Lobes nearly equal, smooth, the cells flat or convex ...3

2 { Margin of postical lobe incurved, entire ...*247. calcarea*
  { Margin of postical lobe flat, spinous-dentate ...*248. Rossettiana*

3 { Leaves much longer than broad; perianths rare ...*250. microscopica*
  { Leaves about as broad as long, very obtuse; perianths usually present ...*249. minutissima*

247. Cololejeunea calcarea (Lib.) Schiffn.

Jungermannia hamatifolia β echinata Hook., Brit. Jung. No. 51 (1813) et Suppl. *pl.* 3 (1816).
Lejeunea calcarea Libert in Ann. Sc. Nat. 6 p. 373 (1820).
Lejeunea echinata Tayl. MS. in G. L. N., Syn. Hep. p. 345 (1844).
Cololejeunea calcarea Schiffn. in Engl. and Prantl I 3 p. 122 (1895).



1. Stem and leaves (postical). 2. Cells of antical lobe. 3. Cells of postical lobe. 4. Perianth.

Monoicous. In small *yellowish*-green and *frequently compact* tufts or patches. Stems 3–8 mm long, prostrate, irregularly subpinnately branched; rhizoids very scarce, *absent on the branches*. Leaves *imbricate*, the antical lobe *erecto-patent*, convex, *ovate-acuminate*, *the apex incurved*, the margin sinuate-dentate from projecting cells, or entire; postical lobe *about half as large*, ovoid, inflated, the free margin *strongly involute* except at apex, with an obtuse frequently indistinct tooth at the free angle and a generally 2-celled tooth between the angle and the keel; cells 14–18 μ, irregularly oblong-quadrate, the walls thin, trigones small, the cells of the *antical lobe* except at base *contracted into conical papillae*, *those of the postical lobe flat*; cuticle sometimes thickened at the apex of the cells; *stylus 2–4 cells long*, the cells uniseriate. *Underleaves absent*. ♀ inflorescence on a short branch with a single innovation. Involucral bracts not or slightly larger than the leaves, patent, slightly complicate, unequally bilobed to about the middle, the antical lobe ovate, acute or acuminate, the postical lobe somewhat smaller, rotund-ovate, the apex rounded or with a point, the margins, especially of the postical lobe, more or less dentate, both lobes papillose with projecting cells. Perianth obovate-clavate to oblong-obovate, longly exserted, obtusely 5-angled above, smooth below, *the upper half* papillose, the apex rounded-truncate, beak very short. Capsule spherical. Spores 30–50 μ, irregular in shape, mostly linear-oblong, frequently angular, pale brown, finely papillose. Androecium usually at the apex of a long branch, bracts in 3–4 pairs, imbricate, resembling the leaves but with the postical lobe larger, the free margin flat or only slightly involute. Antheridia globose, 1–2. Gemmae discoid, rotund, multicellular, on the surface of the leaves, attached by a slender stalk.

HAB. On moss-tufts on rocks, or less frequently directly on the rock, in moist shady places; calcicolous.

DISTRIB. Derby to Caithness, ascending to 2700 ft. alt. in the Highlands; rare; Ireland. Fr. June–July.

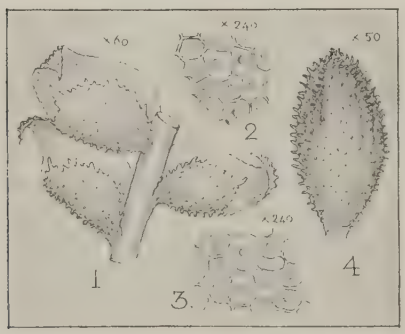
This species rarely occurs on silicious rocks and very rarely on trees; it is

most commonly found on the surface of moss tufts on calcareous rocks. The other small species, except *C. Rossettiana*, are almost confined to silicious rocks or trees. The yellowish-green colour generally allows it to be known in the field, and when it occurs directly on the rock, its very compact patches are noticeable.

The contracted cells of the antical lobe form papillae which can be seen on a front view; this is not the case in *C. microscopica*, where the cells are never more than conical, such cells apppearing papulose only in profile. The postical lobe is so strongly involute that its margins cannot be seen *in situ* except at its truncate apex. The stylus is frequently only permanent near the apex of the stem. The involucral bracts are frequently small and imperfectly formed. The whole surface of the upper half to two-thirds of the perianth is papillose.

248. Cololejeunea Rossettiana (Massal.) Schiffn.

Lejeunea Rossettiana Massal. in Nuove Giorn. Bot. Ital. p. 487 (1889); Pears., Journ. Bot. p. 353 *pl.* 292 (1889).
Cololejeunea Rossettiana Schiffn. in Engl. and Prantl I 3 p. 122 (1893).



1. Stem and leaves (postical). 2. Cells of antical lobe. 3. Cells of postical lobe. 4. Perianth.

Monoicous. In small shallow yellowish-green patches. Stems 3–6 mm long, prostrate, irregularly subpinnately or subfasciculately branched; rhizoids *not scarce to apex of branches*. Leaves imbricate, or approximate, complicate, the antical lobe patent to erecto-patent, convex, *broadly ovate*, *acuminate* or acute, the apex incurved, the margin sinuate-crenulate or subdentate from projecting cells; postical lobe hardly half as large, ovate-quadrate, rounded at the keel, slightly convex, *the free margin flat*, *dentate*, the free angle acute; cells 14–16 μ, irregularly oblong-quadrate, the walls thin, trigones minute, the cells of *both* lobes contracted into long nearly *cylindrical* papillae; cuticle frequently thickened at the apex of cells; stylus composed of a single papilla soon vanishing. Underleaves absent. ♀ inflorescence on a short branch with a single innovation. Involucral bracts suberect, resembling the leaves but slightly larger. Perianth pyriform to broadly oblong-obovate, rather longly exserted, obtusely 5-angled above, *the whole length except at base with long cylindrical papillae*, the apex rounded-truncate, beak very short. Capsule spherical. Spores 30–50 μ, irregular in shape, linear-oblong to rhombic, frequently angular,

brown, finely papillose. Androecium usually on a short branch, bracts in 3–5 pairs, imbricate, resembling the leaves but nearly equally bilobed, ventricose. Antheridia globose, 1–2. Gemmae discoid, rotund, multicellular, on the surface of the leaves attached by a slender stalk.

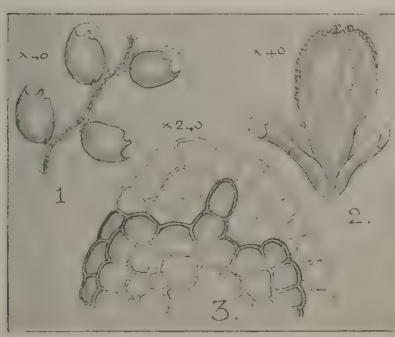
HAB. On rocks in moist shady places; calcicolous.

DISTRIB. Derby to Berwick, very rare; Ireland.

At once distinguished from *C. calcarea*, which sometimes accompanies it, by its very different postical lobe; this lobe is flat and denticulate, not inflated nor with the margin involute, and the surface has conical papilliform cells as in the antical lobe. Other differences include the more branched stems, rhizoids more numerous, leaves more spreading, broader and commonly less acuminate; papillae longer and more cylindrical, stylus soon becoming absorbed and obsolete; involucral bracts more erect and embracing the perianth at the base, the perianth broader and papillose almost to the base, the papillae being longer, and the androecia usually on short branches. This species is generally described as being dioicous, but I find the plants on which I have determined the inflorescence to be monoicous sometimes at least.

249. Cololejeunea minutissima (Sm.) Schiffn.

Jungermannia minutissima Sm., Eng. Bot. *pl.* 1633 (1806).
Jungermannia inconspicua Raddi, Mem. Mat. Soc. Mod. 18 p. 34 *pl.* 5 f. 2 (1820).
Lejeunea minutissima Dum., Comm. Bot. p. 111 (1822).
Lejeunea Taylori Spruce, Ann. Mag. Nat. Hist. p. 116 footnote (1849).
Lejeunea inconspicua De Not., Mem. Acc. Tor. II 22 p. 386 (1865).
Cololejeunea minutissima Schiffn. in Engl. and Prantl I 3 p. 122 (1895).



1. Stem and leaves (postical). 2. Perianth. 3. Cells (apex of leaf).

Monoicous In small, shallow, pale green patches. Stems 4–8 mm long, prostrate, *geniculate*, irregularly branched; rhizoids rather scarce, short. Leaves distant to approximate, the antical lobe *patent*, convex, *subrotund*, occasionally ovate, *the apex rounded*, the margin crenulate with projecting cells; postical lobe slightly smaller, strongly inflated, the free margin involute except near the truncate apex, crenulate with projecting cells, with

an obtuse or rounded, frequently indistinct tooth at or near the free angle and an obtuse 2-celled tooth midway between the angle and the keel; cells 16–21 μ, convex, the walls thin, trigones absent; cuticle smooth; stylus composed of a single papilla, soon vanishing. *Underleaves absent.* ♀ inflorescence on a short or long branch, with one, rarely two, innovations. Involucral bracts larger than the leaves, erecto-patent, slightly complicate, shortly bilobed, lobes narrowly oblong, the postical lobe rather smaller, its margin crenulate and slightly repand, but without teeth. Perianth pyriform, rather longly exserted, acutely 5-angled in the upper part, the cells strongly convex, the beak short and broad. Capsule spherical. Spores 37–50 μ, irregular in shape, mostly narrowly oblong or rhombic, angular, greenish, *asperous.* Androecium on a short or long branch, bracts imbricate, in 3–10 pairs, very concave, nearly equally bilobed, the margins crenulate with projecting cells, but without teeth. Antheridia usually solitary. Gemmae large, discoid, rotund to oblong-oval, multicellular, on the surface of the leaves attached by a slender stalk.

Hab. On stems of trees, rarely on rocks, in shady places.

Distrib. Sussex and Cornwall to Mull and West Inverness, very rare; Ireland.

An easily distinguished species, the subrotund leaves with the apex rounded, together with the absence of underleaves, separate it. Our other species of the genus agree with it in the absence of underleaves, but they have the antical lobe narrowed at the apex. The present plant nearly always grows on wood while the others are almost confined to rocks. The usual presence of perianths will assist in distinguishing it in the field. The geniculate stems are more evident in this plant than in the other *Lejeuneae*, though they are occasionally distinctly present towards the end of the branches in *C. microscopica*.

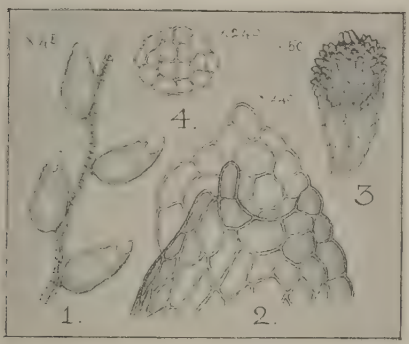
The tooth at the free angle of the postical lobe is readily seen, as the margin is not involute at the apex. The perianth is papillose on account of the strongly convex cells. The spores are occasionally larger than the measurements given. Gemmae are common and are large.

250. Cololejeunea microscopica (Tayl.) Schiffn.

Jungermannia microscopica Tayl. in Mackay, Fl. Hib. 2 p. 59 (1836); Nees, Eur. Leb. III p. 566 (1838).
Lejeunea microscopica Tayl. in G. L. N., Syn. Hep. p. 345 (1844).
Cololejeunea microscopica Schiffn. in Engl. and Prantl I 3 p. 122 (1895).
Aphanolejeunea microscopica Evans, Bull. Torr. Club p. 273 (1911).

Paroicous. In small, shallow *whitish*-green patches or as scattered stems. Stems 3–6 mm long, filiform, translucent, prostrate, flexuous, slightly and irregularly branched; rhizoids somewhat scarce,

rather long. Leaves *distant*, the antical lobe patent to erecto-patent, convex, *narrowly oblong-ovate, the apex narrowed, subacute* or obtuse, the margin not or slightly crenulate with projecting cells; postical lobe slightly smaller, strongly inflated, the free margin *much involute, with a slightly projecting 1-celled tooth at the free angle and a distinct 1-celled tooth beside it, the whole leaf ovoid-fusiform*; cells of antical lobe 16–23 μ, oblong-quadrate, frequently elongate near base, convex to conical-convex except near base, seldom altogether flat, the walls thin, trigones absent; cuticle sometimes thickened at the apex of the conical cells; stylus composed of a single papilla soon vanishing. *Underleaves absent*. ♀ inflorescence on a very short branch, with one or rarely two innovations. Subinvolucral bracts in one pair, similar to but slightly larger than the leaves, not imbricate, the lower situated on the stem, the upper on the base of the branch; antheridium globose, solitary. Involucral bracts longer than the leaves, slightly complicate, the antical lobe narrowly oblong-lanceolate, subacute, the margin crenulate with projecting cells; the postical lobe smaller, less acute; cells in both lobes frequently acutely conical. Perianth obovate-clavate, *longly* exserted, *without angles*, smooth below, papillose with *conical* projecting cells near the apex, the apex truncate, the beak short. Capsule spherical, brown. Spores 21–29 μ, irregular in shape, rhombic to linear-oblong, frequently angular, finely papillose, pale green. Gemmae discoid, rotund to broadly oval, multicellular, on the surface of the leaves attached by a slender stalk.



1. Stem and leaves (postical). 2. Cells (apex of leaf). 3. Perianth. 4. Gemma.

HAB. On moist rocks, very rarely on trees, in sheltered localities.

DISTRIB. Cornwall to West Ross-shire, rare; Ireland.

This minute species can usually be recognised in the field by its distant, narrow leaves; it forms small, nearly white, thin patches on mosses or directly on wet rocks, very rarely on trees. Under the microscope the rather long, scattered rhizoids attract attention. The whole leaf is ovoid-fusiform when well developed, but it varies to being ovoid; it is unlike our other species. The apex of the antical lobe is not incurved as it is in *C. calcarea*, and the postical lobe is nearly as large as the antical lobe; the stylus is almost obsolete, but can be

detected near the apex of the young stems. The tooth at the free angle of the postical lobe is occasionally difficult to see on account of the transparency of the cells, together with the strongly involute border. The leaf-cells are commonly flat or nearly so, on the lower half of the leaf, and are convex to conical towards the apex, but this varies greatly, and all the cells may be flat. The shape of the cells also varies greatly; they are usually more elongate than in *C. minutissima*, and the marginal cells are frequently elongate. The spores can hardly be considered asperous like those of *C. minutissima*; they are finely tuberculate, the tubercles being mostly acutely pointed. A reddish-brown rotifer is common in the leaves of this species, more so than in the other species of this genus.

Evans in "Hepaticae of Puerto Rico," at present being published in "Bull. Torr. Bot. Club," has described a new genus, *Aphanolejeunea*, with our *C. microscopica* as the type species. It includes some tropical species. It is separated from *Cololejeunea* principally by the characters of the postical lobe. In the new genus the apical tooth consists of a single cell which is close to the usually smaller tooth at the angle, the two teeth being separated only by a slight indentation. This gives the apex of the postical lobe the appearance, without careful examination, of being simply acute. A hyaline papilla is present at some distance from the apical tooth, instead of being on it as in the restricted genus *Cololejeunea*. Evans also gives other particulars of the new genus, including the inconspicuous character of all the species, from which the name of the genus is derived.

LXVI. LEJEUNEA Lib.

Lejeunea Libert, Ann. Gen. Sci. Phys. 6 p. 372 (1820).
Lejeunea subgen. *Eu-Lejeunea* Spruce, Hep. Amaz. et And. p. 260 (1884).
Eulejeunea Schiffn. in Engl. and Prantl, Nat. Pflanz. I 3 p. 122 (1895).

Plants small or medium-sized, pinnate or irregularly branched. Leaves *imbricate or contiguous*, the antical lobe usually *widely spreading*, ovate to obovate with the apex rounded or obtuse, the margin entire or crenulate from projecting cells; *postical lobe small*, sometimes obsolete, inflated, rarely plane. Underleaves small, seldom half as large as the leaf, *roundish*, bifid. Leaf-cells thin-walled, transparent, not papillose. ♀ inflorescence terminal on a principal branch, with 1–2 innovations; bracts almost similar to the leaves. Perianth nearly always with 5 acute keels, *the keels smooth or nearly so*. Androecium almost always on a short lateral branch.

1 { Antical lobe of leaves broadly ovate to sub-rotund, convex 2
  { Antical lobe oblong-oval, scarcely or only slightly convex.....3

2 { Underleaves larger than the postical lobe, entire at margin; wings of perianth not or scarcely crenulate.....*253. cavifolia*
  { Underleaves smaller or not larger than postical lobe, crenulate; wings of perianth crenulate.....*254. patens*

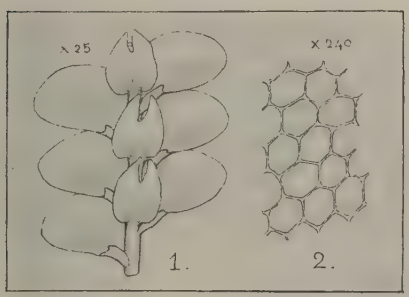
3 { Postical lobe very variable, often half the size of the antical lobe or more *256. diversiloba*
  { Postical lobe small, not half the size of the antical 4

4 { Underleaves about as large as the postical lobe; perianth not angled; plant small.....*255. Macvicari*
{ Underleaves much larger than the postical lobe.....5

5 { Underleaves large, often subimbricate, longer than broad, sinus narrow *251. flava*
{ Underleaves distant, orbicular, with wide sinus .....*252. Holtii*

251. Lejeunea flava (Swartz) Nees

Jungermannia flava Swartz, Prod. Fl. Ind. Occ. p. 144 (1788).
Lejeunea flava Nees, Eur. Leb. III p. 277 (1838).
Lejeunea serpyllifolia β thymifolia Carr., Trans. Bot. Soc. Ed. 7 p. 456 (1863).
Lejeunea Moorei Lindb., Hep. in Hib. lect. p. 487 (1875); Moore, Proc. Roy. Irish Acad. p. 615 *pl.* 44 (1877).



1. Stem and leaves (postical). 2. Cells.

Monoicous. In thin flat *yellowish-green* or green patches creeping over mosses, dull when dry. Stems 15–25 mm long, prostrate, slightly and irregularly branched, seldom pinnate; rhizoids very scarce. Leaves *contiguous to subimbricate*, patent-divergent, the antical lobe slightly convex, *not crossing the stem, obliquely oblong to oblong-oval*, rounded-obtuse at the apex, the margin entire; postical lobe *small*, slightly inflated, subovate, the free margin involute except at the apex, with an obtuse 1-celled tooth at the free angle; cells *17–23* μ, 5–7-angled, nearly flat except towards base of leaf, the walls thin but with occasionally intermediate thickenings, trigones minute, cuticle smooth. *Underleaves contiguous*, subappressed, plane, *oval-oblong* to oval-orbicular, *longer than broad, subcordate or rounded at the base, large, three to four times larger than the postical lobe*, $\frac{1}{3}$ *bilobed*, occasionally to $\frac{1}{2}$ bilobed, the sinus narrow and usually obtuse, lobes subobtuse, the margin entire. ♀ inflorescence on a long or short branch, usually with a single innovation. Involucral bracts larger than the leaves, complicate, unequally $\frac{1}{2}$–$\frac{3}{4}$ bilobed, the antical lobe oblong-oval, obtuse, the postical lobe narrower and shortly oboval, obtuse or subacute; bracteole cuneate-obovate, $\frac{1}{3}$ bilobed, lobes subacute. Perianth slightly emersed, green, pyriform, rounded at the apex, *slightly and obtusely 5-angled above*, the angles smooth or slightly crenulate, the beak short.

Androecium terminal on a short branch, bracts in 2–4 pairs, imbricate, ventricose, shortly and nearly equally bilobed, the lobes obtuse; antheridia in pairs, globose.

HAB. On rocks and trees in moist shady places.

DISTRIB. Killarney, Ireland; very rare.

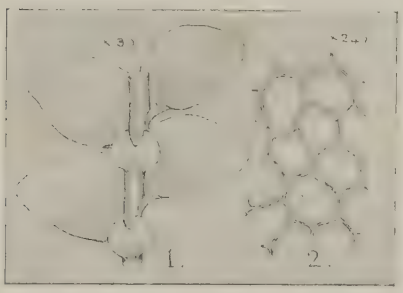
Differs from *L. cavifolia* in the leaves being narrower, more spreading and less imbricate, the antical margin rarely crossing the stem, the postical lobe smaller and less inflated, and the keel less arched, the underleaves larger, closer together and rounded or subcordate at base, the sinus usually narrower and less deep, leaf-cells distinctly smaller, the angles of the perianth obtuse and only slightly raised. The colour of the plant has also a more yellow tinge, or at least dark green, and not pale green as is frequently the case with the other.

Spruce latterly considered his subspecies *albida* of *Hep. Amaz. et And.* p. 219 as distinct from *L. flava*. Evans considers it to be the same species as *L. americana* (Lindb.) Evans, after an examination of Spruce's specimen in *Hep. Spruceanae*. It has been recorded, but incorrectly, from Ireland.

Some leaves of *L. flava* are occasionally shiny when dry, but the whole plant is dull. The antical margin of the leaf is suddenly expanded from a narrow base; it remains broadest at the middle and does not become ovate. In characteristic stems the underleaves are contiguous or subimbricate, but they are frequently distant on part of most stems; the sinus varies, and the lobes may be subacute, or one obtuse and the other subacute; the margin is rarely sinuate. ♀ bracts are common in the Irish plant, and are conspicuous by being much larger that the leaves; they are more deeply divided when perianths are not present. I have found only two perianths, and the bracts varied somewhat. ♂ inflorescence with antheridia is common, but fruit has not been found in Ireland.

252. Lejeunea Holtii Spruce

Lejeunea Holtii Spruce, Journ. Bot. p. 33 (1887); Pears., Hep. Brit. Isles p. 51 *pl.* 13 (1899).



1. Stem and leaves (postical). 2. Cells.

Monoicous. Delicate. In thin flat patches creeping over mosses, dark green or yellowish-green with frequently a reddish tinge, *shining when dry*. Stems 20–30 mm long, prostrate, slightly and subpinnately branched to the middle, the upper part long, straight and unbranched and rarely stratified; rhizoids very scarce. Leaves *distant*, here and there approximate or subimbricate, *patent-divergent*, the antical lobe *almost flat*, seldom crossing the middle of

the stem, *obliquely subovate-elliptical*, *narrowed to the obtuse or sometimes subacute apex*, the margin more or less sinuate, entire; *postical lobe very small*, *frequently almost obsolete*, slightly inflated, subovoid, the free margin involute except at the apex, with an obtuse 1-celled tooth at the free angle; cells *22–30 μ*, frequently to 35 *μ*, 5–7-angled, nearly flat, the walls thin but frequently with intermediate thickenings, trigones minute; cuticle smooth. Underleaves *distant*, erecto-patent, plane, *orbicular*, *not or seldom longer than broad*, subcordate or rounded at the base, about one third the size of the leaves, $\frac{1}{3}$ bilobed, the sinus broad and obtuse, lobes *acute*, occasionally subobtuse. ♀ inflorescence nearly always *on a very short branch*, with or without a single pair of small leaves, *without an innovation*, or rarely with one single and unbranched. Involucral bracts smaller than the leaves, suberect with the margins slightly recurved, subcomplicate, unequally $\frac{1}{3}$–$\frac{1}{2}$ bilobed or sometimes slightly deeper, the antical lobe lanceolate or subovate-lanceolate, acuminate or acute, the postical lobe shorter and less than half as wide, lanceolate-subulate; bracteole elliptical-lanceolate, $\frac{1}{3}$ bilobed, sinus very narrow, lobes broadly subulate, slightly unequal. Perianth longly exserted, broadly pyriform, slightly depressed or truncate at the apex, 5-angled to near the base, *the angles highly winged*, slightly crenulate below, distinctly so near the apex. Androecium usually on a short branch, seldom at the end of a somewhat longer one; bracts in 2–5 pairs, imbricate, ventricose, subequally bilobed, the lobes rounded-truncate at the apex; antheridia solitary ?, globose.

HAB. On wet rocks near waterfalls.

DISTRIB. Killarney, Ireland; very rare.

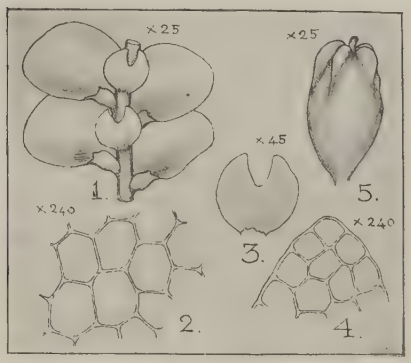
This very distinct species is readily known from *L. cavifolia*, *L. patens*, or *L. flava* by its narrow, distant leaves, which are distinctly narrowed from slightly below the middle to the apex. The ends of the stems are straight and unbranched, giving the plant a characteristic appearance. The underleaves separate this species at once from *L. flava*; in the latter they are larger and are distinctly longer than broad, which is not or seldom the case in the present plant; the sinus is also narrower in *L. flava* and the lobes more obtuse at the apex; also the distance at which they are from one another in *L. Holtii* is different from that of *L. flava*, they are not subappressed to the stem, and are more delicate in texture; the subcordate or rounded base is only seen in well developed underleaves, this applies to both these species but especially to *L. Holtii*. The leaf-cells are much larger than in *L. flava* and are usually longer in proportion to their breath.

Forms of *L. cavifolia* with small lobules can at once be known from *L. Holtii* by their broader leaves which are broadly rounded at the apex; they are more imbricate and more convex as a rule, the underleaves with more obtuse lobes, and the plant less tender, etc. Besides, ♀ inflorescence is common in both plants, and the short branches without innovations of *L. Holtii* at once distinguish it. In our other species the ♀ inflorescence may appear as if lateral on the stem on account of the innovation seeming to be a prolongation of it, but in *L. Holtii* a distinct very short branch is evident.

The antical lobe is broadest just below the middle; it is seldom rounded at the apex. The ♀ branch with its bracts, before the perianth is exserted, is generally shorter than the leaves in this species; the ♂ spikes usually occupy a whole branch and in this case are shorter than the leaves. The bracts and bracteole have lobes usually ending in two single cells. The perianth is exserted for a distance rather longer than the length of the bracts themselves. I have only seen a few antheridia; they appear to be solitary.

253. Lejeunea cavifolia (Ehrh.) Lindb.

Jungermannia cavifolia Ehrh., Beitr. 4 p. 45 (1789).
Lejeunea serpyllifolia Libert, Ann. Gen. Sci. Phys. 6 p. 374 (1820).
Lejeunea cavifolia Lindb., Act. Soc. Sci. Fenn. 10 p. 43 (1871).



1. Stem and leaves (postical). 2. Cells. 3. Underleaf. 4. Apex of do. 5. Perianth.

Monoicous. In flat pale green to green or yellowish-green patches, shining or dull when dry. Stems 12–20 mm long, prostrate, irregularly branched, branches usually numerous; rhizoids scarce. Leaves imbricate, patent, frequently erecto-patent on the branches and apex of stem, the antical lobe slightly convex or flat, crossing the stem, *ovate-oval*, rounded or broadly obtuse at the apex, the margin entire; postical lobe much smaller, strongly inflated, ovate, the free margin involute except at the apex, with an obtuse 1-celled tooth at the free angle; cells 22–28 μ, occasionally to 35 μ, 5–7-angled, slightly convex or flat, the walls thin but frequently with small intermediate thickenings, trigones usually minute; cuticle smooth. Underleaves distant, subappressed, slightly convex or plane, oval-rotund, *narrowed at the base* and not decurrent, *as large as or larger than the postical lobe*, bilobed to the middle, the sinus usually obtuse, lobes obtuse or sometimes subacute, *the margin entire or nearly so.* ♀ inflorescence on a long or short branch, usually with a single innovation. Involucral bracts complicate, unequally bilobed, the antical lobe narrowly and obliquely oblong-obovate, the apex obtuse or subacute, the margin entire, postical lobe much smaller, variable in shape, linear-oblong to lanceolate; bracteole oval to obovate-oval, $\frac{1}{3}$ bilobed, sinus narrow, lobes subacute to obtuse, the margin entire.

Perianth exserted about one half beyond the bracts, oval-oblong from a narrow base, rounded or truncate at the apex, sharply 5-angled above, *the angles smooth* or sometimes slightly crenulate, the beak short. Capsule globose. Spores 28–43 μ, mostly irregularly linear-oblong, with some oval-oblong, frequently angular, greenish-brown, thickly and coarsely papillose. Androecium on a short branch, bracts in 2–4 pairs, ventricose, slightly and nearly equally bilobed, the lobes rounded. Antheridia in pairs, globose. Propagula as leafless shoots from the margin of the leaves and from the side of the stem.

var. **planiuscula** Lindb., Musc. Scand. p. 2 (1879).

Lejeunea cavifolia forma α planiuscula Lindb., Hep. in Hib. lect. p. 484 (1875).

Elongate, pale green; leaves less imbricate, nearly horizontal on the principal stems, the antical lobe large, *less convex and narrower* towards the apex; postical lobe smaller in proportion to the antical lobe; cells commonly only slightly chlorophyllose; *underleaves large, 2–3 times* as large as the postical lobe.

var. **heterophylla** Carr., Trans. Bot. Soc. Ed. 7 p. 457 (1863).

Pale green to yellowish-green; leaves *approximate to somewhat distant*, less frequently slightly imbricate, the antical lobe *nearly flat*, the postical lobe *greatly variable but small or almost obsolete;* leaves on branches usually small and distant; underleaves oblong-oval.

HAB. Rocks and trees in moist shady places.

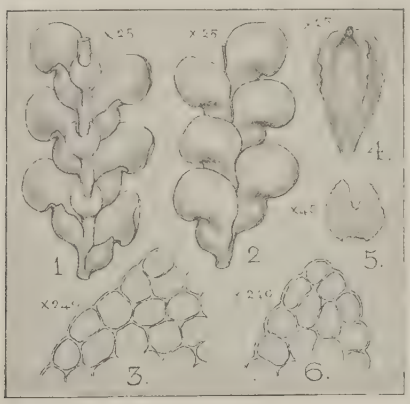
DISTRIB. N. to Shetland, frequent: Ireland. Fr. March–June.

This is the only common species of the genus in Britain. It is seldom difficult to recognise. Notes are given under the species which might be confused with it. The trigones vary considerably in size and are sometimes almost absent; the intermediate thickenings may also be scarcely noticeable. The innovations remain single or become floriferous. The angles of the perianth are not unfrequently crenulate. The ♂ spike occupies the whole of a very short branch.

The var. *planiuscula* is uncommon. It is sometimes mistaken for *L. flava* on account of its large underleaves, but their outline, as well as that of the leaves, is different. The plant figured by Hooker in Plate 42 of his *Brit. Jung.* more resembles this variety than it does the type. The var. *heterophylla*, when well marked, is a distinct looking plant. It is to be expected that the postical lobes should be smaller in wet ground, but this does not alone account for the characters of the variety, as typical *L. cavifolia* frequently occurs on very wet rocks with the postical lobe as large as usual; besides, the var. *heterophylla* has appearance of being a well developed plant, and it frequently bears fruit. The common form of the species varies in the size of its postical lobe, and it occasionally has microphyllous branches, but in this variety these lobes are small or almost obsolete on the principal stems as well as on the branches.

✓254. Lejeunea patens Lindb.

Jungermannia serpyllifolia Dicks., Plant. Crypt. Fasc. 4 p. 19 (1801).
Lejeunea patens Lindb., Act. Soc. Sci. Fenn. 10 p. 482 (1875).



1. Stem and leaves (postical). 2. Do. (antical). 3. Cells. 4. Perianth. 5. Underleaf. 6. Apex of do.

Monoicous. In thin pale green to *whitish-green* patches, shining when dry. Stems 7–12 mm long, prostrate, irregularly and intricately branched, branches numerous; rhizoids scarce. Leaves imbricate, patent to patent-divergent, sometimes erecto-patent, the antical lobe *convex*, frequently strongly so, crossing the stem, *abruptly diverging from the postical lobe and suberect*, decurved when dry, obovate-rotundate to oval-rotundate, broadly rounded at the apex, *the margin crenulate* or subentire; postical lobe much smaller, strongly inflated, ovate, the free margin involute except near the apex, with an obtuse 1-celled tooth at the free angle; cells *16–22* μ, 5–7-angled, convex, the walls thin but frequently with small intermediate thickenings, trigones small, distinct. Underleaves distant, convex, subrotund, narrowed at the base and not decurrent, *smaller than the postical lobe*, bilobed to the middle, the sinus usually obtuse, sometimes acute, *the margin crenulate*. ♀ inflorescence on a long or short branch, usually with a single innovation. Involucral bracts complicate, unequally bilobed, the antical lobe narrowly obliquely oblong-ovate, the apex obtuse or sub-acute, the margin crenulate or entire, postical lobe much smaller, linear-oblong, acute or obtuse; bracteole oval, $\frac{1}{4}$ bilobed, sinus narrow, lobes subacute, the margin crenulate or subentire. Perianth exserted about half beyond the bracts, pyriform-clavate, narrowed towards the base, rounded at the apex, sharply 5-angled for $\frac{1}{4}$–$\frac{1}{2}$ its length, *the angles crenulate*, the beak short. Capsule globose. Spores *16–28* μ, seldom to 35 μ, mostly irregularly oval, with some roundish-quadrate and a few linear-oblong, sometimes angular, greenish-brown, finely papillose. Androecium on a short branch, seldom at the apex of a long branch, bracts in 2–4 pairs, ventricose,

slightly and nearly equally bilobed, the lobes rounded; antheridia in pairs, globose.

HAB. Banks and trees in moist well sheltered places.

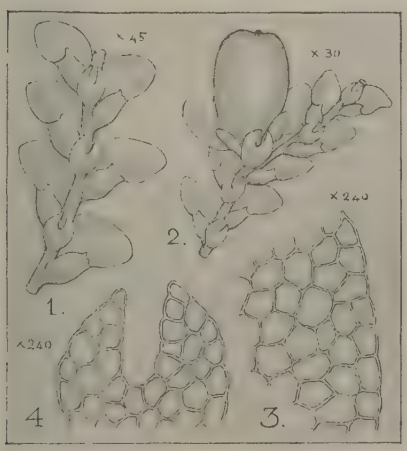
DISTRIB. From Worcester and Wales to Shetland, chiefly in the west; uncommon; Ireland. Fr. May–June.

L. patens when typical is easily known from *L. cavifolia*; but there is frequently much difficulty in distinguishing it. The characters as distinguished from typical *L. cavifolia* are the postical lobe larger or at least not smaller than the underleaf, and the latter with its margins distinctly crenulate through projecting cells, the antical lobe more convex and abruptly rising from the postical lobe and with the margin crenulate, though less strongly so than in the case of the underleaf, the smaller leaf-cells, the perianth broader above and with the angles distinctly crenulate, the smaller and less frequently linear-oblong spores. Other differences are the pale colour, never dull when dry, the smaller size of the plant, the more intricately branched stems, the trigones and intermediate thickenings of the cell-wall more distinct, the crenulate bracteole, and the wings of the perianth frequently extending further down. These differences are all subject to variation; I am doubtful if the two plants can always be separated.

The cell-walls appear thickened under a low power; this is owing to the chlorophyll granules having collected around the margins of the cell. The perianth is occasionally keeled to below the middle and may be exserted more than half beyond the bracts.

255. Lejeunea Macvicari Pears.

Lejeunea Macvicari Pears., Journ. Bot. p. 409 *pl.* 415 (1900).



1. Stem and leaves (postical). 2. Fertile plant. 3. Cells. 4. Underleaf.

Monoicous. Minute. In flat pale yellowish-green patches or scattered among mosses. Stems 5–10 mm long, *not rigid*, slightly and irregularly, sometimes subfasciculately branched, the branches widely spreading or ascending; rhizoids scarce. Leaves approximate to rather distant, erecto-patent, the antical lobe slightly convex, *oblong-oval to oblong-ovate*, the apex rounded-obtuse or obtuse, seldom subacute, the margin slightly crenulate through projecting cells; postical lobe about a third as large as the antical lobe, strongly

inflated, ovoid, the free margin involute except at the apex, with an obtuse 1-celled tooth at the free angle; cells 15–22 μ, hexagonal-quadrate, slightly convex, the walls thin, trigones absent or sometimes present and minute; cuticle smooth. Underleaves usually twice as broad as the stem, of about the same size as the postical lobe, rotund-oval, $\frac{1}{2}$ bilobed, sinus narrow but round at base, lobes frequently incurved, narrowly ovate-triangular, *acute*, commonly four cells broad at base and ending mostly in one cell, but not unfrequently in two single cells, the margin slightly crenulate with projecting cells; ♀ inflorescence on a long or short branch, with a single innovation which is rarely floriferous. Involucral bracts larger than the leaves, laxly complicate, $\frac{1}{2}$ bilobed, the antical lobe *broadly oblong*, rounded-obtuse at the apex, postical lobe $\frac{1}{2}$–$\frac{1}{3}$ as large, narrowly oblong, obtuse at the apex, margin of both lobes slightly crenulate; bracteole broadly oblong, $\frac{1}{3}$ bilobed, the sinus narrow, lobes subacute, the margin crenulate. Perianth exserted about half its length beyond the bracts, oblong-obovate, slightly depressed at the apex, *without angles*, the beak very short. Capsule globose. Androecium occupying the whole of a short branch, bracts in 2–3 pairs, imbricate, greatly ventricose, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, the antical lobe slightly smaller, lobes rounded-obtuse, crenulate; bracteole cuneate-obovate; antheridia globose, solitary.

Hab. Old trees, rarely on rocks, in moist well-sheltered places.

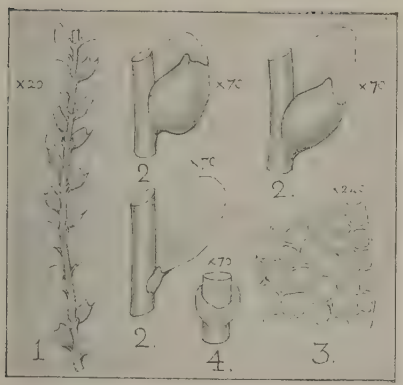
Distrib. Moidart, West Inverness; very rare. Fr. April–May.

This small species is subject to very little variation; it is easily known in the field by its perianths being without angles; when perianths are absent it might be mistaken for a small form of *L. patens* or *Harpalejeunea ovata*. Under the microscope the oblong-oval leaves will at once separate it, those of *L. patens* being much broader and rounder. It is a slightly larger plant than *L. diversiloba*, and the leaves are less erect and do not show the variability which is characteristic of that species; the bracts are quite different as is also the perianth. The postical lobe does not vary in size further than what is commonly seen in all the species of the genus. The underleaves are rather large for the size of the plant; they are erecto-patent, and are usually divided to about the middle, but this varies from $\frac{1}{3}$ $\frac{3}{3}$. When the perianth is collapsed five angles may sometimes be noticed. *L. patens* has a larger perianth.

256. Lejeunea diversiloba Spruce

Lejeunea minutissima β major Carr., Trans. Bot. Soc. Ed. 7 p. 456 (1863).

Lejeunea diversiloba Spruce, Journ. Bot. July (1876); Carr., Trans. Bot. Soc. Ed. 13 p. 468 *pl.* 17 f. 1 (1879); Pears., Hep. Brit. Isles p. 56 (1899).



1. Stem (postical). 2. Leaves. 3. Cells. 4. Underleaf.

Dioicous and monoicous. *Minute.* In pale yellowish-green scattered stems among mosses or rarely in thin patches, nearly white when dry. Stems 10–15 mm long, *rigid*, filiform, slightly and irregularly, sometimes subfasciculately branched, the branches *straight*, *ascending to suberect;* rhizoids rather scarce. Leaves approximate, erecto-patent, the antical lobe slightly convex, *obovate-oblong*, but frequently ovate-oblong or ovoid and *with some smaller and oboval*, the apex rotundate, seldom only obtuse, the margin entire; the postical lobe about half the size of the antical lobe but *greatly variable*, *sometimes nearly equal in size to the antical lobe*, *or small*, *or nearly obsolete*, these frequently occurring intermixed on the same stem; when larger being inflated, the free margin involute except at the apex, with an obtuse or subacute 1–2-celled tooth at the free angle; cells 14–21 μ, oblong-quadrate or hexagonal-quadrate, slightly convex, walls slightly and equally thickened, trigones absent; cuticle smooth. Underleaves small, slightly or not broader than the stem, rotund-oval to quadrate-oval, $\frac{1}{2}$–$\frac{2}{3}$ bilobed, the sinus usually lunate, lobes narrowly triangular-ovate, sometimes broadly subulate, subacute to acute, commonly four cells broad at base, the apex with a single cell, the margin entire. ♀ inflorescence on a short or long branch with a single innovation which is sometimes floriferous, rarely without an innovation. Involucral bracts larger than the leaves, complicate, $\frac{2}{3}$ bilobed, the antical lobe *obovate-lanceolate*, rounded-obtuse or subacute at the apex, the margin distinctly *sinuate-angular* or subentire, the postical lobe equally long but narrower, acute, the margin entire or occasionally with 1–2 teeth; bracteole obovate-lanceolate, divided to below the middle, the lobes lanceolate, acute, entire or with 1–3 teeth. Perianth exserted nearly half its length beyond the bracts, oblong-obovate, obtusely 5-angled, the angles smooth or sinuate, the beak very short. Androecium near the base or apex of a short branch, bracts in 2–3 pairs, imbricate, strongly ventricose, lobes nearly equal.

Hab. Creeping over mosses in well sheltered places.

Distrib. Killarney, Ireland, very rare.

The rigid stem and diversiform leaves of this small species make it easily recognisable. *Microlejeunea ulicina* has the stem and branches somewhat geniculate between each leaf and less rigid, antical lobe always broad and rotund at the apex and convex, the postical lobe hardly variable and always about half the size of the antical lobe, and small trigones are present. The margin of the leaf of *L. diversiloba* is sometimes worn, giving it a crenulate appearance. I have seen one monoicous plant.

LXVII. MICROLEJEUNEA (Spruce) Jack et Steph.

Lejeunea subgen. *Micro-Lejeunea* Spruce, Hep. Amaz. et And. p. 286 (1884).
Microlejeunea Jack et Steph., Bot. Centralbl. 60 (1894).
Eulejeunea subgen. *Microlejeunea* Schiffn. in Engl. and Prantl, Nat. Pflanz. I 3 p. 124 (1895).

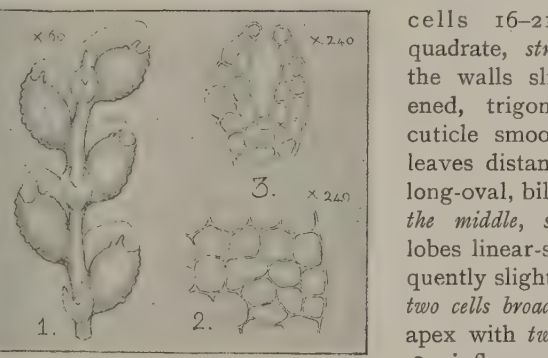
Plants *very small* with sparingly branched stems. Leaves small, distant or subimbricate, *the antical lobe suberect* or obliquely spreading, the margin entire or slightly crenulate; postical lobe inflated, *more than half as large as the antical lobe*, sometimes nearly equalling it. Underleaves distant, small, bifid. Leaf-cells very small, opaque. ♀ inflorescence with one, rarely two, innovations. Perianth with five acute smooth keels.

257. Microlejeunea ulicina (Tayl.) Evans

Jungermannia minutissima Hook., Brit. Jung. *pl.* 52 (1813).
Jungermannia ulicina Tayl., Trans. Bot. Soc. Ed. I p. 115 (1844).
Lejeunea ulicina Tayl. in G. L. N., Syn. Hep. p. 387 (1844).
Microlejeunea ulicina Evans, Mem. Torr. Bot. Club 8 p. 165 (1902).

Dioicous. *Minute.* In thin, flat, pale yellowish-green patches or as scattered stems. Stems 4–8 mm long, prostrate, somewhat rigid, slightly and irregularly branched, the branches widely spreading and straight, though slightly geniculate between each leaf; rhizoids short, scarce. Leaves distant or contiguous, erecto-patent, the antical lobe *strongly convex*, *rotundate-ovate to ovate*, the apex rounded or narrowed and obtuse, the margin entire, but frequently sinuate; postical lobe $\frac{1}{2}$–$\frac{2}{3}$ *as large as the antical lobe*, seldom nearly equalling it in size, ovate, strongly inflated, the free margin usually involute except at the apex, with an obtuse 1-celled tooth at the free

angle and a hyaline papilla at the base of the tooth on its inner side; the keel strongly arched; cells 16–21 μ, oblong-quadrate, *strongly convex*, the walls slightly thickened, trigones minute; cuticle smooth. Underleaves distant, small, oblong-oval, bilobed *to below the middle*, *sinus narrow*, lobes linear-subulate, frequently slightly incurved, *two cells broad at base*, the apex with *two single cells*. ♀ inflorescence on a long or short branch, with a single innovation, simple or branched, seldom with two innovations. Involucral bracts much larger than the leaves, widely spreading, complicate, the keel sometimes winged, antical lobe oblong, rounded-obtuse to acute, the margin distantly crenulate-dentate, postical lobe narrower, acute, crenulate-dentate to subentire; bracteole oblong, narrowed towards the base, $\frac{1}{4}$ bilobed, sinus acute, lobes acute, the margin entire, somewhat sinuate. Perianth pyriform, 5-angled. Androecium occupying a short branch, bracts in 2–3 pairs, imbricate, strongly ventricose, lobes nearly equal.



1. Stem and leaves (postical). 2. Cells. 3. Underleaf.

HAB. On trees and on *Ulex*, very rarely on rocks, in sheltered places.

DISTRIB. N. to Ross, almost confined to the west, locally frequent; Ireland.

The species has much resemblance in the field to *C. minutissima* and can hardly be distinguished from it, except by the absence of perianths; these being nearly always present in *C. minutissima*. Under the microscope the underleaves of the present plant at once separate it; the underleaves will also separate it from *L. diversiloba* and from *L. Macvicari*, as, besides other differences, the lobes nearly always end in two single cells, while on the other hand they nearly always end in a single cell in the two other species. The postical lobe does not vary as in *L. diversiloba* and the antical lobe is much rounder than in most of the leaves of that species or in any of those of *L. Macvicari*. The stem and branches are more geniculate than in either of them; but although geniculate between the leaves, the branches themselves are straight. In the larger leaves the antical lobe is frequently broadly expanded near the base and rather suddenly narrowed near the apex. The trigones can generally be seen, but not always. The margins of the ♀ bracts and bracteole are crenulate with projecting cells, but in addition, the margins of the bracts have the cells projecting into distant, obtuse teeth.

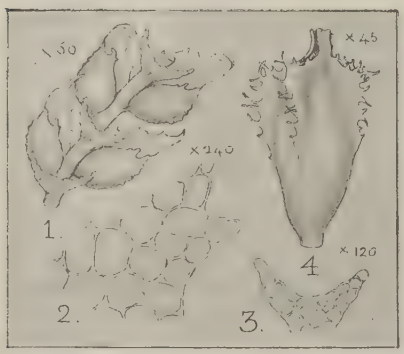
LXVIII. DREPANOLEJEUNEA (Spruce) Schiffn.

Lejeunea subgen. *Drepano-Lejeunea* Spruce, Hep. Amaz. et And. p. 186 (1884).
Drepanolejeunea Schiffn. in Engl. and Prantl, Nat. Pflanz. I 3 p. 126 (1895).

Plant *small or minute*. Leaves distant, obliquely spreading or almost erect, the antical lobe lanceolate, elongate, *acuminate*, strongly *incurved* at the apex, the margin spinulose or crenate; postical lobe ovate, inflated. Underleaves small, *bifid to below the middle, segments divaricate, subulate and acute*. Perianth with the keels dilated into nearly horizontal dentate or spinulose horns.

258. Drepanolejeunea hamatifolia (Hook.) Schiffn.

Jungermannia hamatifolia Hook., Brit. Jung. *pl.* 51 (1813).
Lejeunea hamatifolia Dum., Comm. Bot. p. 111 (1822).
Drepanolejeunea hamatifolia Schiffn. in Engl. and Prantl I 3 p. 126 (1895).



1. Stem and leaves (postical). 2. Cells. 3. Underleaf. 4. Perianth.

Monoicous. *Minute*. In thin flat pale yellowish-green patches or as scattered stems among mosses. Stems 4–10 mm long, prostrate, slightly and subpinnately branched, the branches widely spreading; rhizoids short, scarce. Leaves approximate, erecto-patent, the antical lobe convex, *ovate-lanceolate, acuminate*, the *apex incurved* and ending commonly in two single cells, the antical margin *with 2–4 spinous teeth*, mostly one cell long, or with the teeth broad at base and obtuse, the postical margin entire or with a single projecting cell forming an obtuse tooth; postical lobe about half as large as the antical lobe, inflated, the free margin involute except at the apex, with an *elongated and somewhat curved* 1-celled tooth at the free angle and a hyaline papilla at the base of the tooth on its inner side, the keel strongly arched, crenulate from projecting cells; cells 16–21 μ, oblong-quadrate to rotund-quadrate, convex, frequently strongly so and occasionally conical-convex, the walls

slightly thickened, trigones small; cuticle smooth. Underleaves distant, about $\frac{2}{3}$ *bifid*, the basal portion 2–3 cells high, inversely triangular, the sinus lunulate, *segments divaricate, subulate*, 2–3 cells broad at base and 4–5 cells long. ♀ inflorescence on a short branch with a single and usually simple innovation. Involucral bracts larger than the leaves, laxly complicate, antical lobe oblong-ovate, acuminate, spinous-dentate, the postical lobe narrower, spinous-dentate to dentate; bracteole $\frac{1}{3}$ bilobed, lobes acuminate, spinous-dentate. Perianth pyriform, sharply 5-angled above, *the angles winged and spinous-setose*, the beak short. Androecium at the end of a long branch, bracts in 3–4 pairs, imbricate, ventricose, nearly equally bilobed, lobes acute or apiculate, not incurved, the antical lobe slightly dentate; antheridia solitary. Propagula as short bud-like branches from the side of the stem, having more or less deformed leaves and underleaves.

Hab. On rocks and trees in moist well-sheltered places.

Distrib. Wales to Ross, confined to the west, rare; Ireland.

The underleaves allow this species to be easily recognised. They are composed of a broad portion two to three cells high, and two widely spreading segments which are 4–5 cells long and usually 2 cells wide at base, the sinus between them being lunulate. The antical lobe resembles a good deal in shape those of *Cololejeunea calcarea* and *C. Rossettiana*, but the latter are without the teeth on the antical margin which are present in most of the leaves of *D. hamatifolia*; these teeth vary a good deal in size and are sometimes nearly obsolete, but never on all the leaves of a stem, and they can always be detected in every specimen; they are placed at about the middle of the margin or slightly lower down. As underleaves are absent in *Cololejeunea* the present plant need not be confused with any species of that genus.

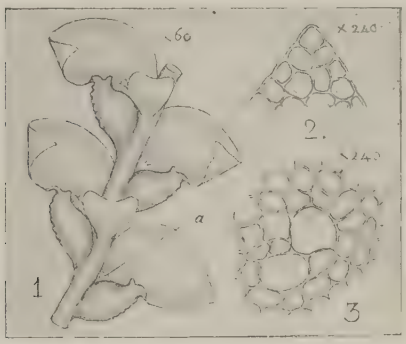
LXIX. HARPALEJEUNEA (Spruce) Schiffn.

Lejeunea subgen. *Harpa-Lejeunea* Spruce, Hep. Amaz. et And. p. 164 (1884). *Harpalejeunea* Schiffn. in Engl. and Prantl, Nat. Pflanz. I 3 p. 126 (1895).

Plant *small*. Leaves widely spreading, the antical lobe obliquely ovate, *acute or acuminate*, somewhat incurved at the apex, the margin entire, crenulate, or serrulate; postical lobe rather large, inflated. Underleaves rotund to cuneate, *emarginate or bilobed but never beyond the middle, segments broad, rounded or obtuse at the apex*. Perianth pyriform, the keels smooth or roughened, rarely spinulose.

259. Harpalejeunea ovata (Hook.) Schiffn.

Jungermannia serpyllifolia β ovata Hook., Brit. Jung. No. 42 *β* (1813)
Lejeunea ovata Tayl., G. L. N. Syn. Hep. p. 376 (1844).
Lejeunea Molleri Steph., Hedwigia p. 3 *pl.* 1 f. 2 (1887).
Harpalejeunea ovata Schiffn. in Engl. and Prantl p. 127 (1895).



1. Stem and leaves (postical). 2. Basal cells at *a* (fig. 1), showing ocelli. 3. Apical cells.

Dioicous. *Minute.* In thin pale yellowish-green to green patches or as scattered stems among mosses. Stems 8–12 mm long, prostrate, irregularly branched; rhizoids short, scarce. Leaves contiguous or subimbricate, patent to erecto-patent, the antical lobe convex, *subovate - falcate*, rising abruptly from the postical lobe, the apex extending outwards and incurved, *subacute or acute*, on the branches shortly acuminate, the antical margin strongly arched, *entire* or sinuate, the postical margin slightly arched, entire; postical lobe about a third to half as large as the antical lobe, ovoid, strongly inflated, the free margin involute except at the apex, with an obtuse 1-celled tooth at the free angle, the keel strongly arched, crenulate from projecting cells; cells 16-20 μ, oblong-quadrate to oblong-hexagonal, convex, the walls thin, trigones small, ocelli present as two to five enlarged and thin-walled cells near the base of the lobe; cuticle smooth. Underleaves distant, about twice as broad as the stem, *obcordate-triangular, the apex broadly emarginate* or nearly truncate, *the lobes rounded.* ♀ inflorescence on a long or short branch, usually with a single and simple innovation. Involucral bracts larger than the leaves, complicate, unequally bilobed, the keel sometimes winged, antical lobe oblong-oval, subacute, postical lobe narrower and short, obtuse or rounded at the apex; bracteole obovate-cuneate, $\frac{1}{4}$ bilobed, lobes rounded at the apex. Perianth obovate-clavate, sharply 5-angled above. Androecium occupying a short branch, bracts in 1–2 pairs, imbricate, unequally bilobed, antical lobe oval obtuse, postical lobe similar but smaller.

Hab. On rocks and trees in moist, well-sheltered places.

Distrib. Wales to Ross, confined to the west, locally frequent; Ireland.

The form of the underleaves will at once separate this species; they are expanded from a narrowed base and are only emarginate. It is rather difficult to distinguish in the field from *Drepanolejeunea hamatifolia*, especially as both species are frequently found together; on close examination with a lens, the broader upper part of the antical lobe of *H. ovata* can be distinguished on those leaves which show their postical surface, but on a profile view the lobe appears to be narrow as in *D. hamatifolia*. The tooth at the free angle of the lobule is frequently difficult to detect on account of the margin becoming incurved to beyond the place where it is found. The description of the male inflorescence is taken from Pearson.

LXX. MARCHESINIA S. F. Gray

Marchesinius S. F. Gray, Nat. Arr. Brit. Pl. 1 p. 689 (1821).
Phragmicoma Dum., Comm. Bot. p. 112 (1822).
Lejeunea subgen. *Homalo-Lejeunea* Spruce, Hep. Amaz. et And. p. 132 (1884).

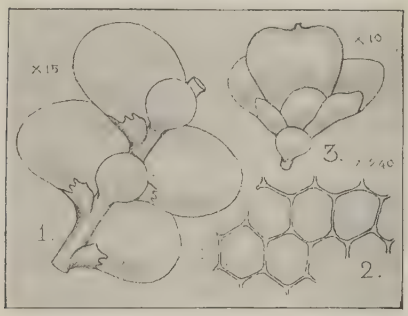
Plants *large, brown or greenish-brown.* Stems usually irregularly pinnate. Leaves more or less imbricate, the antical lobe ovate to orbicular-ovate, entire or dentate at the apex; postical lobe small, inflated at the base, otherwise plane, the free margin usually 1–2-dentate. *Underleaves large, orbicular or reniform, undivided.* ♀ inflorescence on a principal branch innovating on both sides. Perianth large, *obcordate, strongly compressed, plane on both surfaces* or with an indistinct postical keel, apex truncate.

260. Marchesinia Mackaii (Hook.) Gray

Jungermannia Mackaii Hook., Brit. Jung. *pl.* 53 (1813).
Marchesinius Mackaii Gray, Nat. Arr. Brit. Pl. I p. 689 (1821).
Phragmicoma Mackaii Dum., Comm. Bot. p. 112 (1822).
Lejeunea Mackaii Sprengl., Syst. Veg. 4 p. 233 (1825).

Monoicous. In flat *olive-green to blackish-green*, occasionally reddish-brown patches. Stems 15–30 mm long, prostrate, irregularly pinnate; rhizoids reddish-brown or colourless, short, sometimes numerous. Leaves *imbricate, horizontal*, the antical lobe nearly flat, slightly incurved at the apex, *suborbicular*, the antical margin strongly arched and crossing the stem, the postical margin slightly arched, *the apex rotundate*, margin entire but usually more or less sinuate; postical lobe small, quadrate-ovate, slightly inflated, the free margin involute or flat, with an obtuse 1-celled papilla above

the middle, the free angle with a tooth and an additional tooth *between the angle and the keel*, the keel straight or slightly arched; cells 23–30 μ, of nearly equal size except at base, rounded-hexagonal, convex, the walls slightly thickened and frequently with slight intermediate thickenings, trigones small, cells at base larger and oblong with rather large trigones. Underleaves approximate, *large*, about three times as broad as the stem, flat, *orbicular*, the apex frequently *subtruncate*, seldom retuse, the base narrow, *margin entire* but frequently sinuate. ♀ inflorescence on a long or short branch innovating on one or both sides, the innovations frequently floriferous. Involucral bracts slightly larger than the leaves, complicate, unequally bilobed, antical lobe oblong-obovate, the apex broadly obtuse, margin entire or sinuate, the postical lobe about one third the size of the antical lobe, oblong-oval, the apex obtuse, margin sinuate; bracteole cuneate-oblong, apex retuse, the margin entire or slightly sinuate. Perianth exserted rather more than half its length beyond the bracts, *obcordate-obovate, strongly compressed*, decurved when young, the beak short with the mouth entire. Capsule globose. Androecia at the end of rather long branches which bear small leaves and underleaves at the base, bracts in 4–6 pairs, closely imbricate, ventricose, smaller than the leaves, $\frac{1}{3}$ bilobed, the antical lobe oblong-oval, the postical lobe slightly smaller, both lobes entire, rotundate at the apex; antheridia in pairs, globose.



1. Stem with leaves and underleaves.
2. Cells. 3. Perianth.

HAB. On shaded or exposed rocks.

DISTRIB. Cornwall to Skye, rather rare, rare inland; Ireland. Fr. Spring.

This uncommon species might be overlooked by the beginner for a *Radula* or *Frullania*, but it is nearly always of a darker colour than any of our species of these genera, and the presence of underleaves will distinguish it from the former, while the differently shaped postical lobe as well as the entire or retuse underleaf will separate it from the latter. This species usually grows on the vertical face of rocks and mostly on limestone. It is much larger than the other *Lejeuneae* and is about the size of *Radula complanata*. Although the plant is usually blackish-green, it is sometimes reddish-yellow or reddish-brown. The postical lobe is variable, being frequently small and without teeth or even nearly

obsclete. The margin of the antical lobe of the ♀ bract is frequently considerably sinuate or even sometimes lobulate-sinuate; it is sometimes broader below than above the middle.

Tribe **Frullanieae.**

Plants uusually large, generally reddish-brown, seldom green, frequently pinnate, the branches contiguous to the *inner base* of the leaves, i.e., intra-axillary. Innovations rarely present. *Postical lobe distant from the stem, galeate or saccate*, or sometimes only evolute, attached to the postical margin of the antical lobe close to the base. ♀ inflorescence 2–12-gynous, rarely 1-gynous. Pedicel of capsule short, rarely cruciate in section.

This tribe is composed of the two genera *Frullania* and *Jubula*. A branch arises from the whole of a postical segment, so that the postical lobe of the leaf below which it arises is absent. The postical lobe is distant from the stem and is not attached by a broad fold to the antical lobe, as in the *Lejeuneeae*. The stylus, placed between the postical lobe, of which it is a part, and the stem, is generally present; it is usually a small subulate process and is sometimes very minute or obsolete.

LXXI. JUBULA Dum.

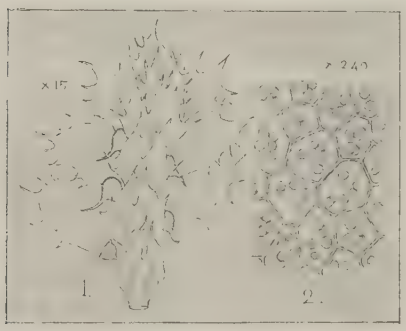
Jubula Dum., Comm. Bot. p. 112 (1822) emend. Rec. d'obs. p. 12 (1835); Spruce, Hep. Amaz. et And. p. 58 (1884).
Lejeunea p.p. Corda in Opiz Nat. p. 652 (1829).
Frullaniae sp. Nees, Eur. Leb. III p. 240 (1838).

Plants rather large, dark green, pinnately branched; branches lateral with an antical elobulate leaf at the insertion of each, seated *partly on the stem and partly on the branch*. Leaves incubous, antical lobe usually *dentate or spinulose; cell walls thin*, slightly or not thickened at the angles; postical lobe *distant from the stem*, small, saccate, rarely evolute, acuminate. ♀ inflorescence with *two*, rarely one, *opposite subfloral innovations*, bracts in one pair, archegonia 1–2, rarely 3–4. Perianth 3-angled, smooth. Pedicel of capsule cruciate in section, articulate when dry.

This genus is in some respects intermediate between the *Lejeuneeae* and *Frullania*. Innovations are present and are adnate to the bracts as in the *Lejeuneeae*, and the insertion of the leaf, the leaf-cells, and the pedicel of the capsule are more like those of that group, while the ramification and postical lobe are more those of *Frullania*. This matter is fully gone into by Spruce in his *Hep. Amaz. et And.*, which the student should consult.

261. Jubula Hutchinsiae (Hook.) Dum.

Jungermannia Hutchinsiae Hook., Brit. Jung. *pl.* 1 (1812).
Jubula Hutchinsiae Dum., Comm. Bot. p. 112 (1822).
Frullania Hutchinsiae Nees, Eur. Leb. III p. 240 (1838),



1, Stem with leaves and underleaves.
2. Cells.

Monoicous. In flat *dark green* to dark olive-green patches. Stems 2–4 cm long, prostrate, flexuous, irregularly pinnate, the branches patent or horizontal, sometimes again divided; rhizoids scarce, reddish-brown or colourless. Leaves imbricate, horizontal, the antical lobe nearly flat, *obliquely and broadly ovate, cuspidate to acuminate at the apex*, the antical margin strongly arched but seldom crossing the stem, the postical margin nearly straight or slightly arched, *both margins, but especially the antical, spinous-dentate*, the teeth commonly five to six in number and three to six cells long; postical lobe at some distance from the stem and subparallel to it, *galeate*, inflated, the mouth truncate, frequently with a *narrow spur-like appendage* at its outer angle, the lobe sometimes only evolute and lanceolate; cells 25–33 μ, 5–7-angled, with 4–7 round to oval shining oil-bodies and numerous chloroplasts, walls thin, trigones absent, the cells at margin with slightly thickened walls; stylus composed of a one-celled papilla, soon becoming obsolete. Underleaves suborbicular, decurrent, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, lobes ovate-acuminate, the margins *with 1–2 narrow spinous teeth* or entire. ♀ inflorescence on a long branch with innovations most frequently on both sides, the innovations frequently floriferous. Involucral bracts $\frac{1}{4}$ bilobed, complicate, slightly longer than the leaves, the antical lobe oblong-ovate to oblong-lanceolate, longly acuminate, the upper half of both margins spinous-dentate; the postical lobe half as long or sometimes less, the antical margin subentire or entire, the postical margin spinous-dentate; bracteole more deeply divided, the lobes subulate-lanceolate, longly acuminate, margin spinous-dentate. Perianth exserted for half its length, or more, beyond the bracts, composed of one layer of cells, obovate-clavate, terete at the base, highly trigonous above, the apex rounded-truncate, beak

very short, crenulate, at length trifid, the teeth entire or slightly dentate, angles of perianth crenulate with projecting cells. Capsule globose, blackish-brown, shining, the walls strongly recurved on dehiscence. Spores 16–21 μ, rotund and broadly oval, green with a slight brownish tinge, papillose. Elaters 220–250 μ long by 7–8 μ broad, arising from the upper half of the capsule-wall, straight, truncate at the end, with a broad reddish-brown spiral. Androecia about the same length as the leaves, bracts in 3–4 pairs, imbricate, complicate, ventricose, $\frac{1}{3}$ bilobed, the antical lobe ovate, acuminate, sinuate or with a spinous tooth on the margin, postical lobe slightly smaller, subacute, seldom acuminate, entire; antheridia in pairs, oval-globose.

HAB. On very wet or dripping rocks in caves and in fissures of rocks, especially in well sheltered ravines.

DISTRIB. Cornwall to West Inverness, confined to the west, rare; Ireland.

This species cannot be mistaken, the spinous-dentate leaves not occurring in any other with the least resemblance to it. It is sometimes rather difficult to detect when in thin layers in wet caves, but usually some stems can be seen hanging loosely, and their glistening appearance attracts attention.

Carrington in *Trans. Bot. Soc. Ed.* p. 457 (1863) gives a var. *compacta*, "stem gracile, closely imbricated; leaves smaller, more convex," growing in drier places in Killarney. This does not seem to be more than a drier ground form, as the habit and size of the species varies a good deal. A form occurs in Scotland having the postical lobe explanate, seldom saccate, and with the antical lobe narrower than in the type, and the margins with fewer spinous-teeth. Etiolate forms are sometimes seen in Wales and the west of Ireland; these have the margins of the leaves with the armature much reduced, the teeth being shorter, fewer and even almost absent on some leaves, the terminal spines being also much reduced, the postical lobe evolute and the underleaves smaller. The var. *integrifolia* Lindb., *Hep. in Hib. lect.* p. 474, appears to be one of those forms; the var. *integrifolia* of Moore in *Proc. Roy. Irish Acad.* p. 609 pl. 45, is described as being practically without postical lobes. I have not been able to see a specimen of the plant. Nees' *Frullania Hutchinsiae* var. B "foliis integerrimis" in *Syn. Hep.* p. 775, from North America, has the margin of the leaves and bracts entire with the exception of a shortened spinous tooth or spine. This was given the specific name *F. pennsylvanica* by Stephani in *Hedwigia* p. 147 (1883) and *Jubula pennsylvanica* by Evans in *Rhodora* p. 56 (1905). Spruce describes the same plant as *Jubula Hutchinsiae* var. *Sullivanti* in *Hep. Amaz. et And.* p. 62 (1884).

The vegetative branches in this species arise in the same manner as in the species of *Frullania*, but the δ branches and the subfloral innovations arise as in those of *Lejeunea*. The antical lobe when well developed has spinous-teeth on the upper margin for two thirds of its length, and for about one third on the lower margin; the teeth vary greatly in size, the apical one being the largest and commonly triangular-acuminate; the others vary from 1–6 cells in length and are usually about two cells broad at base. Except in the growing cells the chloroplasts are collected around the walls. The oil-bodies are also to be seen in the perianths. The underleaves are usually oblong to oblong-oval on the branches. The spinous teeth on the margin of the bracteole are narrower than those on the bracts. The apex of the perianth becomes slit for about its whole length. The

spores are mostly rotund but several are broadly oval, rarely is there an obtuse angle at one point; a few of the spores measure up to 25 μ in diam.

LXXII. FRULLANIA Raddi

Frullania Raddi, Atti Soc. Ital. Sc. Mod. (1818); Mem. Mat. Soc. Ital. Sc. Mod. 18 p. 20 (1820); Spruce, Hep. Amaz. et And. p. 3 (1884).

Plants usually large, rarely small, *reddish-brown*, sometimes almost black, seldom green, *pinnately branched*. Leaves incubous, very shortly and *nearly transversely inserted*, the antical lobe obliquely ovate to suborbicular, almost always quite entire; *postical lobe cucullate, galeate or saccate*, sometimes evolute, usually with a minute subulate process or rudimentary sac (stylus) situated between it and the stem. Leaf-cells *with thickened walls* and well marked trigones. Underleaves always present, bilobed, very rarely entire. ♀ inflorescence *without innovations*, archegonia 2–4, rarely more; bracts in 2–5 pairs, usually dentate or laciniate, the innermost generally adnate to each other and to the bracteole. Perianth trigonous with the third angle postical, or tetragonous with two postical angles. Calyptra fleshy; pedicel of capsule short, not cruciate in section nor articulate when dry.

The commonly reddish-brown, pinnate stems of *Frullania* are unlike those of our other Hepaticae, so that the genus need seldom give trouble in distinguishing it in the field. The underleaves, which are always bilobed, must be examined in mature parts of the main stem or principal branches, those near the apices not being typical. The involucral bracts and bracteole afford characters of great importance. The pedicel of the capsule consists of four concentric layers of alternate cells.

1 { Antical lobe of branch leaves, at least, usually with enlarged cells, forming a line or scattered over the leaf 2
  { Antical lobe always without such enlarged cells 5

2 { Underleaves with recurved margin ..... *263. Tamarisci*
  { Underleaves with plane margin 3

3 { Underleaves $\frac{1}{2}$ divided with acute lobes ..... *264. microphylla*
  { Underleaves $\frac{1}{5}$–$\frac{1}{3}$ divided with obtuse lobes 4

4 { Leaves caducous, enlarged cells scattered; underleaves usually with truncate lobes ..... *266. fragilifolia*
  { Leaves not caducous, enlarged cells, or some of them, in a continuous line; underleaves seldom with truncate lobes ..... *265. maritima*

5 { Perianth tuberculate; postical lobe ½ the breadth of antical lobe; underleaves usually with a tooth at side ..... *267. dilatata*
Perianth smooth; postical lobe ¼–⅛ the breadth of antical lobe; underleaves without a tooth at side..... *262. germana*

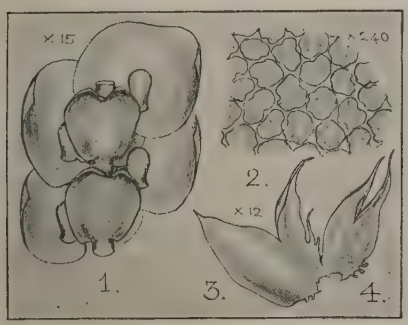
Subgen. **Thyopsiella** Spruce

Thyopsiella Spruce, Hep. Amaz. et And. p. 7 et p. 41 (1884).

Postical lobe cylindrical-saccate, longer than broad. Perianth smooth.

262. Frullania germana Tayl.

Jungermannia germana Tayl., Ann. Mag. Nat. Hist. p. 173 (1843); Trans. Bot. Soc. Ed. 2 p. 45 (1846).
Frullania germana Tayl., G. L. N. Syn. Hep. p. 450 (1844); Pears. Hep. Brit. Isles p. 31 *pl.* 4 (1899).
Frullania Tamarisci var. *germana* Carr., Trans. Bot. Soc. Ed. p. 457 (1863).



1. Stem with leaves and underleaves.
2. Cells. 3. Bract. 4. Bracteole.

Dioicous. In large depressed and usually loose patches, *yellowish-brown to pale reddish-brown*, less frequently dark reddish-brown. Stems 3–8 cm long, rigid, dark brown, procumbent but sometimes prostrate, commonly bipinnate, the branches generally short and thick; rhizoids fasciculate, rather scarce. Leaves imbricate, the antical lobe *subreniform* to orbicular-ovate, cordate at base, widely crossing the stem, the apex decurved, apiculate, rounded, or acute, on the branches often acuminate; postical lobe oblong-cylindrical, slightly contracted at the base, shorter and much narrower than the underleaves, parallel to the stem, saccate, sometimes evolute; stylus filiform or disc-like; cells 16–21 μ, roundish or oblong, the walls usually much thickened, trigones and intermediate thickenings generally large, *enlarged discoloured cells absent*; cuticle smooth. Underleaves large, about *thrice* as broad as the stem, *rotundate*, on

the branches oblong-rotund to oblong-obovate, shortly decurrent, slightly auriculate but seldom crispate at base, $\frac{1}{6}$–$\frac{1}{5}$ bilobed, the sinus obtuse, lobes subobtuse or apiculate, the *margin generally recurved at the apex only*. ♀ inflorescence terminal on a short branch. Involucral bracts unequally bifid, the antical lobe oval-lanceolate, acuminate, *entire or sinuate*, rarely with 1–2 obtuse teeth near the apex, with 1–3 papilliform cilia at the antical base; postical lobe narrowly lanceolate and longly acuminate, the margins revolute with a large tooth near the middle commonly ending in two long cilia and with 1–4 cilia at base of the bract; bracteole oblong-oval, connate on one side with the base of the bract, bilobed to about the middle, with the lobes narrowly lanceolate and longly acuminate, *margins entire and with only 1–2 cilia at base*. Perianth exserted for half its length, oblong-obovate, trigonous, smooth, the apex slightly narrowed, rounded-truncate, beak cylindrical, rather short. Capsule globose. Spores 40–56 μ, oblong or roundish, mostly somewhat obtusely angular, brown, with several large tubercular warts. Elaters reddish-brown. Male plant laxly pinnate. Androecium on a short lateral branch, *oblong-ovate to linear*, bracts usually in *6–12* pairs, seldom to 24 pairs, imbricate, ventricose, nearly equally bilobed to the middle or deeper, lobes broadly ovate-oval, rounded at the apex, the antical lobe with 1–3 cilia at the base, the postical lobe rather smaller with a 1–4-celled tooth near the apex and 1–3 cilia at the base; bracteole flat, connate with the bracts on one side at the base, or free.

HAB. On shady rocks and trees near the west coast.

DISTRIB. Cornwall to Shetland, rare except in the western part of the Highlands and in the Hebrides; Ireland. Fr. Aug.–Oct.

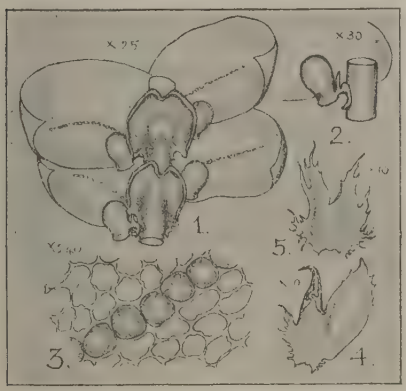
Can be generally known in the field from *F. Tamarisci* by its dull colour; it never grows in loose suberect tufts among mosses or other herbs as that species sometimes does. The trigones and intermediate thickenings are larger and the nodular cells at the base of the antical lobe are more distinct and extend for a further distance up the centre of the leaf than in the other; the postical lobe also is rather more distant from the stem. The underleaves are typically rotundate, three times broader than the stem, with the apex only recurved, or even almost flat, but they are not uncommonly narrower and sometimes with the margins recurved to near the base as in *F. Tamarisci*; they are very often without an auricle, and this is rarely spurred (hastate) and very seldom crispate. The leaves on the branches are seldom cordate at base. The perianth is oblong-oval before the capsule is mature but finally it is oblong-obovate, there being practically no difference between the perianths of the two species. Spores and elaters are similar. The difference between the innermost involucral bracts of the two species is given in the description. The bracteole gives the best character and is unfailing as a distinction. Short and long mature androecia can be seen on the same stem but the bracts are never reduced to less than four pairs and in this it is quite distinct from *F. Tamarisci*.

F. germana does not vary greatly. A rather distinct form—*forma explanata*—from the Island of Mull, has the antical lobes of the stem-leaves oblong, not cordate at base, apiculate, rather seldom acuminate, those of the bracts oblong-oval to oblong-elliptical, postical lobe most frequently evolute, antical lobe of involucral bracts longly and rather suddenly acuminate. It resembles the type in size.

F. germana is very closely related to *F. Teneriffae* Nees and is possibly not distinct from it.

263. Frullania Tamarisci (L.) Dum.

Jungermannia Tamarisci L., Sp. Pl. p. 1134 (1753).
Frullania Tamarisci Dum., Rec. d'obs. p. 13 (1835).



1. Stem with leaves and underleaves.
2. Base of leaf, with stylus. 3. Cells.
4, Bract. 5. Bracteole.

Dioicous. In *shining*, depressed and usually large and loose patches, reddish-brown in colour, seldom dark green. Stems 3–10 cm long, filiform, rigid, dark brown, prostrate or ascending, denudate below, commonly bipinnate; rhizoids fasciculate, reddish-brown or colourless, rather scarce. Leaves imbricate, the antical lobe orbicular-ovate, *deeply cordate at base*, crosing the stem, convex, the apex decurved, apiculate or acute, seldom obtuse, on the branches often acuminate; *postical lobe oblong-cylindrical*, contracted at the base, shorter and narrower than the underleaves, saccate, sometimes evolute; stylus filiform or disc-like; cells 16–20 μ, roundish, the walls more or less thickened, trigones and intermediate thickenings generally small except towards the base; *enlarged discoloured cells in a median line*, also freqently scattered, especially towards the apex of the leaf, most commonly present in the stem leaves, *always present in the British plant on some leaves on the ultimate branches;* cuticle smooth. Underleaves about twice as broad as the stem, oblong-quadrate, shortly decurrent, *auriculate and usually crispate at base*, $\frac{1}{5}$–$\frac{1}{3}$ bilobed, the sinus and the *lobes obtuse* or subacute, sometimes acute on the branches, *the margin revolute for two-thirds of its length.* ♀ inflorescence terminal on a short branch. Involucral bracts unequally bifid, the antical lobe oblong-oval, acute or cuspidate, irregularly dentate to

serrate-dentate, sometimes only crenulate or subentire, with 1–3 papilliform cilia at the antical base, postical lobe lanceolate, acuminate, the margins revolute with a broad tooth or lobe below the middle on one or both sides and with a cluster of cilia at the base on the inner side; bracteole oblong, free or connate on one side with the base of the bract, bilobed to the middle, with the lobes lanceolate-acuminate, margins *variously dentate and laciniate-ciliate* and with a *cluster of cilia* at the base on each side. Perianth exserted for about half its length beyond the bracts, oblong-obovate, trigonous, smooth, the apex slightly narrowed but round, beak cylindrical, rather short. Capsule globose, pedicel very short. Spores 40–56 μ, oblong or roundish, frequently somewhat obtusely angular, pale brown, with several large tubercular warts. Elaters reddish-brown. Male plant more slender. Androecium on a short lateral branch, globose-ovate, bracts in 3–4 pairs, imbricate, ventricose, nearly equally $\frac{1}{3}$–$\frac{1}{2}$ bilobed, lobes broadly oval, rounded or obtuse at the apex, the antical lobe with 1–2 cilia at the base, the postical lobe rather smaller with a 1–4-celled tooth near the apex; bracteole with flat margins, connate with the bracts at the base. Antheridia 2–3, oval-globose.

var. **robusta** Lindb., Hep. in Hib. lect. p. 475 (1875).

2–3 times as large as the type, stout, forming *dense patches* loosely attached to rocks; principal branches *almost quite simply pinnate*, the branchlets *dense and short;* otherwise as the type.

var. **cornubica** Carr. in Carr. and Pears., Hep. Brit. Exs. nr. 49 (1878).

Very small; reddish or yellowish-brown, forming small dense patches closely attached to rocks. Stems regularly pinnate and plumose, in habit and size resembling *F. microphylla; leaves obliquely oval*, acute or apiculate, but sometimes a few leaves rounded-obtuse at the apex, on the branches frequently *elliptical* or almost obovate, line of enlarged cells continuous; underleaves narrowly oblong, $\frac{1}{4}$ bilobed, the lobes acute or subacute, the margin irregularly reflexed, on the ultimate branches more deeply divided and with the lobes acute and the margin plane.

var. **atrovirens** Carr., Trans. Bot. Soc. Ed. p. 457 (1863).

Stems elongated; *indigo-green*, forming wide, shallow patches on wet rocks; antical lobe *elliptic-ovate*, apiculate or acute; postical

lobe *frequently explanate*, underleaves large, shortly lobed, the lobes acute, margin only slightly reflexed.

HAB. On rocks and trees, stems of shrubs and old heather.

DISTRIB. N. to Shetland, very common except in the drier districts, ascending to 3200 ft. alt. in the Highlands of Scotland; Ireland. Fr. June–Oct., but most frequent in August.

This common species is greatly variable in size and habit; it is frequently as large or sometimes even larger than *F. germana*, and is not rarely as small as *F. fragilifolia* and *F. microphylla*. The antical lobe in our plant is nearly always more or less acute and I have never seen a specimen from our islands in which there could not be seen the moniliform line of cells (ocelli) on some of the leaves; the latter character serves as a distinction between it and *F. germana*, but this line is stated to be sometimes absent in the *F. Tamarisci* of other countries; the characters shewn from the androecium and involucral bracts must be considered more important, these are noted under *F. germana*. The ocelli sometimes occur in a double row and are very often somewhat irregularly arranged, but they are seldom scattered as in *F. fragilifolia*. The stylus is variable in shape, being generally more or less subulate and sometimes crispate at the base. The underleaves on the principal branches are always reflexed at the margin, but towards the apex of the ultimate branches they are sometimes flat and with the lobes acute; the lobes appear more obtuse than they actually are on account of the margins being reflexed. The cells at base of leaf are large, linear-oblong and more or less nodulose from the thickened walls. The involucral bracts are dentate only on the upper half or two-thirds. The perianth is narrowed at the apex, but the apex remains round. The spores are mostly oblong. A rotifer may frequently be seen in the lobule in our species of this genus and in *Jubula Hutchinsiae*.

The var. *robusta* is usually reddish-brown. Lindberg describes it as commonly paler in colour than the type; it is sometimes more pellucid, but his characters derived from the moniliform line of cells and from the postical lobe do not differ from what is observed in the common forms of the species. This variety is easily recognised in the field and is confined or almost so to the Atlantic coasts of Britain and of Ireland. Lindberg mentions it as occurring on trees as well as rocks. I have seen it only on rocks in Scotland and generally close to the sea-shore.

The var. *cornubica* is sometimes mistaken for *F. microphylla*, but the underleaves on the stem and principal branches have revolute margins and the leaves are mostly narrow with the apex acute. A few leaves may sometimes be seen in this variety in which the apex is rounded-obtuse. Involucral bracts have not been observed. This plant is confined to rocks on the Atlantic coast.

I have not been able to see an authentic specimen of the var. *atrovirens*, but a plant which occurs on the west coast of Scotland, but rarely, is probably the same as Carrington's Killarney plant from which he took the description. The var. *explanata* Kaal. in *De Dist. Hep. Norv.* p. 97, 1893 has the postical lobe more markedly explanate than the Scottish specimens which I have considered to be the var. *atrovirens*.

264. Frullania microphylla (Gottsche) Pears.

Frullania Tamarisci var. *microphylla* Gottsche in Gott. and Rabh., Hep. Eur. exs. no. 209 (1862); Carr., Trans. Bot. Soc. Ed. p. 457 (1883).

Frullania microphylla Pears., Journ. Bot. p. 328 (1894); Hep. Brit. Isles p. 26 *pl.* 2 (1899).

1. Stem with leaves and underleaves.
2. Cells. 3. Bract. 4. Bracteole.

Dioicous. Small. In thin, flat, dark reddish-brown patches closely attached to rocks, seldom on trees. Stems 2–4·5 cm long, filiform, dark brown, prostrate, shortly pinnate below, *2–3 pinnate and plumose above*, the larger branches long, ascending, the ultimate branches short, numerous and regularly disposed; rhizoids fasciculate, colourless, rather numerous. Leaves imbricate, the antical lobe orbicular-ovate, subcordate at base, or more frequently broadly oval and slightly narrowed at base, not caducous, crossing the stem, convex, *the apex not decurved*, *rotundate*, postical lobe *large*, oblong-cylindrical, slightly contracted at the base, shorter and narrower than the underleaves, saccate; stylus filiform, to 6 cells long; cells *12–15* μ, roundish, the walls usually considerably and nearly equally thickened, enlarged cells, in a *continuous* and usually branched line, always present, also frequently with a few scattered cells. Underleaves about twice as broad as the stem, or less, appressed to the stem, narrowly oblong-quadrate to obovate-oval, shortly decurrent, not or slightly auriculate at base and not crispate, *bilobed to below the middle*, the sinus narrow, lobes *acute or subacute*, *the margins always plane*, entire. ♀ inflorescence terminal on a short branch. Involucral bracts unequally bilobed, the antical lobe oval-lanceolate to obovate-lanceolate, acute or cuspidate, irregularly dentate to serrate-dentate, or crenulate, with 1–5 papilliform cilia at the antical base; postical lobe subovate-lanceolate, acuminate, the margins reflexed, with a large acute tooth about the middle on one side, the margins dentate to sinuate and with a few distant papillae above the base on the inner side; bracteole oval-oblong, free or connate on one side with the bract, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, sinus very acute, the lobes somewhat divaricate, lanceolate, acuminate, *slightly ciliate and dentate*, with 1–3 papillae at the base. Perianth exserted for half its length, *oblong*, broadly obovate when young, trigonous, smooth, with many scattered enlarged cells, the broad emarginate or truncate beak cylindrical and short. Capsule globose. Spores 35–45 μ, oblong to roundish, mostly obtusely angular, pale brown, with several large tubercular warts. Elaters reddish-brown. Male

plant laxly pinnate or slightly bipinnate. Androecium on a short lateral branch, globose; bracts in 1–2 pairs, imbricate, ventricose, nearly equally bilobed, the antical lobe broadly oval, rounded at the apex, with 1–2 cilia at the base, postical lobe rather smaller, oval, apiculate, with a 1–2-celled tooth near the apex; bracteole connate with the bracts on one side at the base. Antheridia oval-globose.

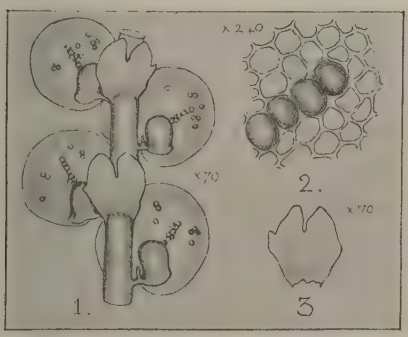
HAB. On perpendicular shady rocks on the west coast.

DISTRIB. Cornwall to Mull and West Inverness, very rare; Ireland.

This pretty and distinct species is confined to the western sea-board or nearly so; it is very closely attached to nearly perpendicular rocks in moist and shady but not wet places. It can be recognised at once from small forms of *F. Tamarasci* by the margins of the underleaves being always flat, the lobes longer, narrow and acute, and the antical lobe of leaf never apiculate. The antical lobe of the involucral bract is frequently cuspidate, the postical lobe is less recurved and is without the cluster of cilia at the base, the bracteole is without laciniae and is nearly flat, and is very different from that of *F. Tamarisci*, as is also the perianth which is of about the same diameter throughout, the apex being broad. The leaf-cells are smaller and less convex than in *F. Tamarisci*. The leaves are more translucent than in any of the other species. The margins of the underleaves are occasionally sinuate, rarely with a broad, angular tooth on one side. The cell-walls are sometimes thin, with small trigones and intermediate thickenings. The antical lobe of the involucral bracts is occasionally, though seldom, entire.

265. Frullania maritima Steph.

Frullania maritima Steph., Spec. Hep. IV p. 568 (1911).



1. Stem with leaves and underleaves. 2. Cells. 3. Underleaf.

Dioicous. Small. In thin, flat, reddish-brown patches on rocks. Stems 2–3 cm long, brown, prostrate, 2–3-pinnate, the larger branches long and ascending, the ultimate branches short; rhizoids scarce. Leaves contiguous to imbricate, the antical lobe subrotund to broadly oval, *not caducous*, crossing the stem, convex, *the apex rotundate*; postical lobe oblong-cylindrical, narrower than the underleaves, saccate; stylus filiform, to 6 cells long; cells 14–18 μ, roundish, the walls more or less thickened,

trigones small, *enlarged cells forming a continuous line*, with others scattered over the leaf. Underleaves about twice as broad as the stem, *obcuneate to oblong-obcuneate*, not auriculate or crispate at base, $\frac{1}{5}$–$\frac{1}{3}$ *bilobed, sometimes to nearly* $\frac{1}{2}$ *bilobed*, the sinus usually narrow, the lobes *broadly triangular*, occasionally oblong, *the apex rounded-obtuse* to subacute, rarely subtruncate, *the margins plane*, frequently with an obtuse tooth at the side. Involucral bracts large for the size of the plant, the antical lobe *longly spathulate*, apiculate, *quite entire*; postical lobe oblong, acuminate, the internal margin with a strong lacinia; bracteole highly connate with the bract on one side, oblong-elliptical, twice as long as broad, inciso-bifid to the middle, the lobes lanceolate, acuminate, *quite entire*.

HAB. On rocks near the coast.

DISTRIB. Moidart, West Inverness, 1900 *(S. M. Macvicar)*; Unst, Shetland *(D. Lillie)*.

This new species was based on a Moidart specimen which was sent by the writer to Herr Stephani among *F. microphylla*, and on a specimen gathered by Carreiro in the Azores. Herr Stephani kindly returned one or two stems of the Moidart plant, and also sent a stem of the other. Unfortunately there are not any involucral bracts on either of these stems, and it is difficult to separate them on this account from *F. fragilifolia*. In fact, I should have considered the Moidart specimen, at least, to be that species. I have re-examined the rock on which the specimen was gathered, but have not been able to find any species except *F. fragilifolia*, *F. microphylla* and *F. Tamarisci*. However, I have been puzzled for some years over a plant which I have hitherto included with *F. fragilifolia*, but on which involucral bracts have never been met with. It differs from that species in the leaves not being caducous, the ocelli in a continuous line, the underleaves with the lobes usually broadly triangular and seldom truncate at the apex. This is probably Stephani's species, but the matter is open to doubt as long as the bracts have not been found. According to Stephani's description of the bracts, which is given above, they must be quite different from those of our other species.

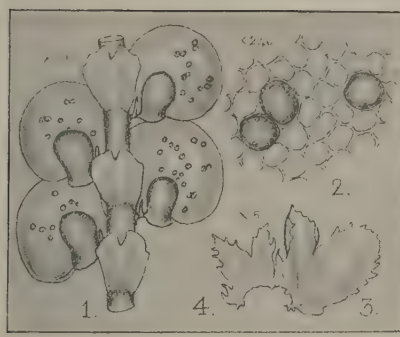
F. maritima appears to be intermediate in character between *F. fragilifolia* and *F. microphylla*. The underleaves are not rarely divided to the middle, and with the lobes subacute. Stephani describes the lobes as being themselves shortly 3-lobed on the outer margin, but this is rather frequently seen in *F. fragilifolia*. The antical lobe of the involucral bracts in *F. microphylla* is occasionally quite entire, but on the same plant may be seen dentate antical lobes.

These three species can be distinguished from small forms of *F. Tamarisci* by the antical lobe of the leaves having always a rotundate apex.

A specimen from Killarney, gathered by Mr. D. A. Jones, has a good deal of resemblance to *F. maritima*, but the underleaves are less deeply bilobed and less obcuneate.

266. Frullania fragilifolia Tayl.

Frullania fragilifolia Tayl., Ann. Mag. Nat. Hist. p. 172 (1843); Pears., Hep. Brit. Isles p. 29 *pl.* 3 (1899).



1. Stem with leaves and underleaves.
2. Cells. 3. Bract. 4. Bracteole.

Dioicous. Small. In thin flat reddish-brown to bright reddish patches, closely attached to rocks and trees. Stems 8-20 mm long, brown, prostrate, *frequently partly denudate*, irregularly 1 – 2-pinnate, sometimes slightly tripinnate, not plumose above, the branches divaricate or ascending; rhizoids fasciculate, colourless, rather scarce. Leaves laxly imbricate, *suberect*, the antical lobe subrotund to obliquely rotund-obovate or broadly oval, usually broad at base but *with a narrow attachment to the stem* and thus readily caducous, crossing the stem, convex, *the apex rounded* and somewhat decurved; postical lobe *oblong-obovate*, contracted at the base, shorter and narrower than the underleaves, saccate, frequently caducous; stylus filiform, to 6 cells long; cells 16–21 μ, roundish, walls somewhat thickened, trigones small, cells at base oblong with greatly thickened walls and large trigones, *enlarged cells scattered*. Underleaves with their upper part about twice as broad as the stem or more, *obcuneate*, shortly decurrent, not auriculate nor crispate at base, $\frac{1}{5}$–$\frac{1}{3}$ *bilobed*, *lobes obliquely truncate* at the apex, *the margins plane*, with an obtuse tooth on each side above the middle. ♀ inflorescence terminal on a short branch. Involucral bracts unequally bilobed, the antical lobe oval-obovate, *obtuse*, *coarsely and generally obtusely serrate-dentate*, with frequently a tooth or lobe at the antical base and 1–3 papillae; postical lobe oblong, *apiculate or obtuse*, the margin reflexed, serrate-dentate to subentire with a large sometimes branched segment or tooth from above the base; bracteole oblong, connate on one side with the bract, $\frac{1}{3}$–$\frac{1}{2}$ bilobed, sinus recurved, obtuse at base, lobes triangular, acute or cuspidate, or shortly acuminate, often unequal, the margins serrate-dentate. Perianth more than half its length exserted, oblong-clavate or *obovate*, trigonous, smooth, rounded-truncate at the apex, the beak short, perianth when young broadly obovate and emarginate at the apex. Spores 40–56 μ, oblong to roundish, obtusely angular, pale brown, with several large tubercular warts. Elaters reddish-brown. Androecium on a short lateral branch, globose, bracts in 2 pairs, imbricate, ventricose, the antical lobe broadly ovate-oval,

rounded at the apex with 1–3 papilliform cilia at the base, postical lobe rather smaller, oval, rounded-obtuse, with a 1–3-celled tooth near the apex; bracteole linear-cuneate, connate with the bract on one side at the base. Antheridia oval-globose.

HAB. On rocks and trees, prefering sheltered localities but sometimes exposed.

DISTRIB. Cornwall to Shetland, uncommon except in the western Highlands, ascending to 2700 ft. alt. in Perthshire; Ireland. Fr. April–July.

The obcuneate underleaves, which are obliquely truncate at the apex, allow this species to be easily known, also, though not quite so certainly, the greatly scattered ocelli. The leaves are attached by a very narrow base, and this generally causes the plant to be recognised in the field, as they remain attached to the finger when pressed against the wet plant, more so than in the other species, and parts of the stem are frequently denudate. The involucral bracts and perianth are unlike those of the other species. The postical lobe is closer to the stem than in *F. microphylla* and its base more frequently divergent; on the main stem the lobes are subparallel in *F. microphylla*, though frequently divergent at the base on the branches; in the present plant they are frequently divergent even on the stem and on the branches they may be greatly so. The leaf cells are larger than in the other. It agrees with *F. microphylla* in having the antical lobe rotundate at the apex and in the underleaves being plane. The underleaves have occasionally a broad tooth or lobe below the middle. The postical lobe of the ♂ bract has frequently one cell projecting beyond the apex but hardly enough to make it apiculate. The teeth of the involucral bracts frequently become gemmiferous at the apex.

SUBGEN. **Trachycolea** Spruce

Trachycolea, Spruce Hep. Amaz. et And. p. 7 et p. 31 (1884).
Galeiloba Steph., Spec. Hep. IV p. 358 (1910).

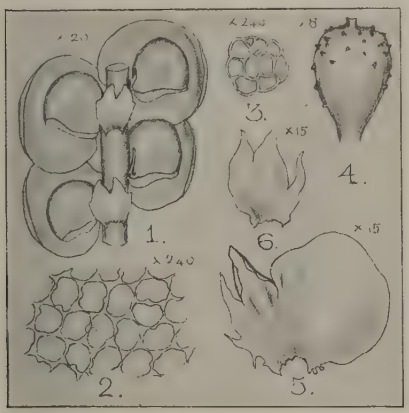
Postical lobe galeate, truncate at base, about as broad as long. Perianth rough with tubercles, papillae, or leafy scales.

267. Frullania dilatata (L.) Dum.

Jungermannia dilatata L., Sp. Pl. p. 1133 (1753).
Frullania dilatata Dum., Rec. d'obs. p. 13 (1835).

Dioicous. In *dull* thin flat patches, closely attached to trees and less frequently to rocks, reddish brown in colour. Stems 2–4 cm long, prostrate, irregularly 1–2-pinnate, the branches patent; rhizoids fasciculate, rather numerous. Leaves closely imbricate, the antical lobe reniform-orbicular, cordate at base, crossing the stem, slightly convex, *the apex rounded on both stem and branches*, shortly decurved; postical lobe *close to the stem*, galeate, compressed and truncate at the base, one half to one third as large as the antical lobe and *nearly as large or larger than the underleaves*; stylus filiform; cells 16–21 μ, roundish, walls considerably thickened, trigones rather large,

intermediate thickenings frequent except towards base, *enlarged discoloured cells absent;* cuticle smooth. Underleaves only slightly broader than the stem, orbicular to broadly oval, $\frac{1}{3}$ bilobed, sinus and lobes acute, *the margin plane* with generally a tooth on each side. ♀ inflorescence terminal on the stem or principal branches. Involucral bracts unequally bifid, the antical lobe broadly oblong-obovate, *rounded at the apex, entire*, with 1–2 papillae at the antical base; postical lobe lanceolate, subacute or apiculate, the margins recurved, with a large ovate to lanceolate segment from near the middle and one or more teeth above the base; bracteole oval, $\frac{1}{3}$ bilobed, sinus and lobes acute, the margins on one or both sides near the middle with a lanceolate tooth. Perianth exserted for about half its length, oblong-obovate, trigonous, *tuberculate*, the apex broad and rounded-truncate, when immature emarginate, the beak short. Capsule globose, pale yellowish-brown. Spores .40–.56 μ, oblong or roundish, usually somewhat obtusely angular, pale brown, with several large tubercular warts. Elaters reddish-brown. Male plants pinnate or slightly bipinnate. Androecium on a short lateral branch, *oblong-ovate to linear*, bracts in *6–20* pairs, imbricate, ventricose, nearly equally $\frac{1}{3}$–$\frac{1}{2}$ bilobed, antical lobe oblong-ovate, rounded at the apex, with 1–2 papillae at the base, the postical lobe rather smaller, obliquely oval, apiculate or subacute, with a 1–4-celled tooth near the apex. Gemmae on the margin and surface of the leaf, roundish, glomerulate, brown to purplish-brown, and on the perianth as irregular outgrowths composed of three to six cells.



1. Stem with leaves and underleaves. 2. Cells. 3. Gemma. 4. Perianth. 5. Bract. 6. Bracteole.

var. **microphylla** Nees, Eur. Leb. III p. 218 (1838).

In loose green patches. Stems rather flaccid, leaves less closely imbricated and usually smaller.

HAB. On trees and rocks.

Distrib. N. to Shetland, very common except in exposed districts; Ireland. Fr. Dec.–April.

This common species can nearly always be easily distinguished in the field by its dull colour and the tuberculate perianths which are seldom altogether absent. It forms very thin, more or less round patches closely attached to the bark of trees, less frequently to rocks. The large galeate postical lobe, and the flat underleaves with commonly a tooth at each side, will assist the beginner in recognising the plant, as well as the absence of a moniliform line of cells. The gemmae form leafy propagula on the leaves, also rarely on the perianths. Jack mentions gemmae composed of elliptical cells on the margin of the ♂ bracts. I have not seen this.

Order IV.

ANTHOCEROTALES

Gametophyte a *thallus* with pores on the ventral, and sometimes also on the dorsal, side. *In each cell is one large chloroplast.* Rhizoids smooth. Antheridia arising *endogenously*, sunk in cavities near the dorsal surface. Sporogonium *pod-like with a bulbous foot but without a pedicel*, its walls with chlorophyll and *having stomata.* The mature capsule dehiscing from the apex downwards by two valves. *A central columella developed, its apex being arched over by the spore-forming layer.* With the spores are (in our species) *angular bent sterile cells* (pseudo-elaters).

Family VI. ANTHOCEROTACEAE

Characters of the Order.

LXXIII. ANTHOCEROS L.

Anthoceros Mich., Gen. Pl. p. 10 (1729).
Anthoceros L., Sp. Pl. p. 1139 (1753).

Thallus suborbicular, variously lobed with the lobes more or less divided, of several layers of nearly uniform cells in the middle, almost always without a sharply defined costa and a one-layered lamina. Involucre cylindrical. Capsule linear, bivalved, much longer than the involucre, its epidermis with stomata; columella always developed. Pseudo-elaters very rarely showing spiral thickenings.

1 { Thallus with channelled dichotomous costate segments; spores yellow *273. dichotomus*
  { Thallus without such segments 2

2 { Spores yellow, granulose-papillate; thallus without lacunae on section *272. laevis*
  { Spores black, spinous; thallus with large lacunae 3

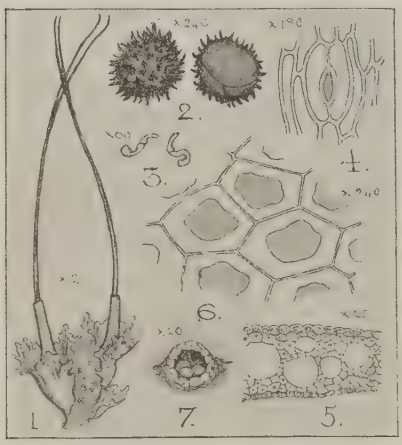
3 { Antheridia about 20 in each cavity; thallus flat ..... *271. Stableri*
  { Antheridia 2–5 in each cavity; thallus usually with raised margins 4

4 { Thallus 15–25 cells high in the middle ..... *270. Husnoti*
  { Thallus 8–15 cells high in the middle 5

5 { Thallus crispate, divided into many lobes on the margin, dorsal surface with several lamellae; some pseudo-elaters 3–5 cells long ..... *269. crispulus*
  { Thallus rough but not crispate, divided into fewer lobes; dorsal surface with few or no lamellae; pseudo-elaters seldom more than 1–3 cells long *268. punctatus*

268. Anthoceros punctatus L.

Anthoceros punctatus L., Sp. Pl. p. 1139 (1753); Nees, Eur. Leb. IV p. 338 (1838).



1. Fertile thallus. 2. Spores. 3. Pseudo-elaters. 4. Stoma. 5. Section of thallus. 6. Cells. 7. Male receptacle.

Monoicous. In pale green patches, blackened when dry. Thallus 5–12 mm in diam., depressed in the centre, with the margins ascending and undulate, variously but not greatly divided into cuneate lobes, the dorsal surface more or less warty, with few or almost without lamellae, not costate; surface cells 35–60 μ × 30–35 μ, each with a large, angular chloroplast; transverse section *8–12 cells* high in the middle, becoming 3–2 cells high at the margin, the interior cells much larger than the epidermal and hyaline, *lacunae large and numerous*. Involucres frequently geminate, 2·5–4·5 mm long × ·4–·5 mm broad, cylindrical, slightly narrowed at the nearly truncate apex. Capsule 20–30 mm long × ·25–·45 mm broad, dark brown to black; stomata 60 × 35 μ, variable in length and breadth. Spores 36–46 μ, *black*, the convex face *with numerous spines*; pseudo-elaters 50–110 μ, mostly *1–2 cells long*, with a few 3 cells long, dark brown, geniculate Antheridia 2–5 in groups in small receptacles scattered over the dorsal surface of the thallus.

Hab. Moist soil in fallow fields, banks and side of ditches.

Distrib. N. to Caithness, uncommon; Ireland. Fr. July–Nov.

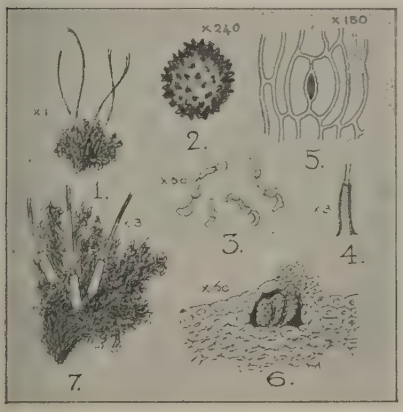
As *A. Husnoti* and *A. crispulus* have only recently been separated from this species in Britain, its position with us is somewhat doubtful. The thickness of the thallus in the two segregates varies considerably, as do also the surface characters of *C. crispulus*. *A. punctatus* is here intended for the plant with few lamellae on the dorsal surface or with lamellae sometimes absent, the thallus 8–12 cells high in the middle, and with the pseudo-elaters seldom more than 1–2 cells long. Further investigation is necessary before it can be definitely stated if this plant is permanently distinct in Britain from the other two.

269. Anthoceros crispulus (Mont.) Douin

Anthoceros punctatus β *multifidus* Nees, Eur. Leb. IV p 340 (1838).

Anthoceros punctatus α *crispulus* Mont. in Webb et Berth., Hist. ins. Can. Bot. p. 64.

Anthoceros crispulus Douin, Rev. Bryol. p. 25 (1905); Nicholson, Hast. and East Sussex Nat. 1, 6 p. 290 (1911).



1. Fertile thallus. 2. Spore. 3. Pseudo-elaters. 4. Involucre. 5. Stoma. 6. Section through male receptacle. 7. Portion of thallus enlarged.

Monoicous. In *small, pale green* patches. Thallus *4–9 mm* in diam., nearly circular, depressed in the centre, the margin ascending, *divided into numerous, narrow, linear or cuneate lobes*, the dorsal surface *rough with several leaf-like lamellae* giving the plant a crisped appearance, not costate; surface cells 50–80 μ × 35–42 μ; transverse section of middle of the thallus *10–15* cells high, the lacunae large. Involucres frequently geminate, 2–4 mm long × ·5–·8 mm broad, cylindrical, slightly narrowed to the almost truncate apex, the mouth sometimes becoming scarious. *Capsule slender*, 15–20 mm long × ·25–·38 mm broad, black; stomata 50 × 35–40 μ, generally shorter and rounder than in *A. punctatus*. Spores 38–50 μ, black, the convex surface with numerous spines. Pseudo-elaters 50–200 μ long × 12–16 μ broad, fuscous, *1–5 cells long*, but mostly of only 1–2 cells. Antheridia in groups of 3–5 in receptacles with a denticulate margin, scattered over the dorsal surface of the thallus.

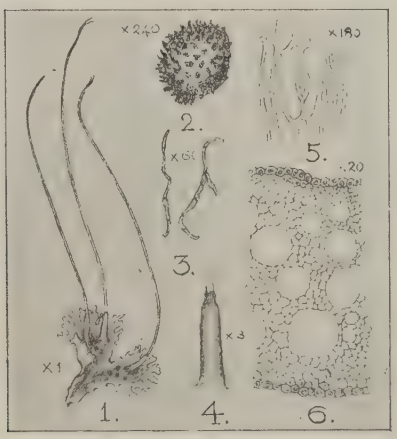
Hab. Moist soil in fields and side of drains.

Distrib. N. to Wales, locally common. Fr. July–Nov.

The small, circular, light green crisped patches of characteristic specimens are very distinct and are easily distinguished in the field, but sometimes the thallus is less divided into small lobes and the lamellae are less numerous; in these cases it is difficult to find a limit between it and *A. punctatus*. The pseudo-elaters are more frequently composed of a larger number of cells, but the characters drawn from the capsule, stomata and spores appear to be of little value in distinguishing the plant from *A. punctatus*.

270. Anthoceros Husnoti Steph.

Anthoceros Husnoti Steph., Rev. Bryol. p. 49 (1888); Nicholson, Hast. and East Suss. Nat. 1, 6 p. 291 (1911).



1. Fertile thallus. 2. Spore. 3. Pseudo-elaters. 4. Involucre. 5. Stoma. 6. Section of thallus.

Monoicous. In pale green patches, blackened when dry. Thallus 15–20 mm in diam., *broadly goblet shaped, ascending to suberect from a depressed* centre, divided to the middle into cuneate lobes which are subdivided into broadly linear, entire or lobulate and somewhat crispate segments, the dorsal surface without or rarely with 1–2 short lamellae, not costate; surface cells 45–70 μ × 30–42 μ. Transverse section of middle of thallus *20–25 cells* but extending to more than 30 cells high, lacunae large and numerous. Involucres usually *single*, 3–5 mm long × ·5–1 mm broad, cylindrical, slightly narrowed towards the apex, the mouth lobulate. Capsule *very long*, *25–35 mm* long × ·3–·45 mm broad; stomata variable, averaging 50 × 42 μ. Spores 36–48 μ, black, the convex surface with numerous spines. Pseudo-elaters 60–250 μ × 9–15 μ broad, fuscous, *2–5 cells long* with some 1-celled and short.

Hab. Moist banks.

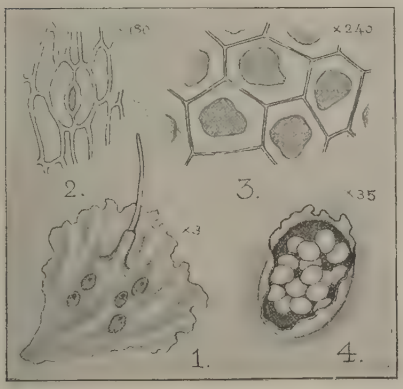
Distrib. N. to West Inverness-shire, uncommon. Fr. June–Aug.

This is a more southern and a larger plant that *A. punctatus*. The thallus is thicker, sometimes as much as 30 cells high at the middle, the capsules rarely

geminate, longer, and the pseudo-elaters mostly composed of more cells. It is represented in Husnot's *Hep. Gall. Exs.* no 171, accompanied by the original description.

271. Anthoceros Stableri Steph.

Anthoceros Stableri Steph., Rev. Bryol. p. 74 (1895); Stabler, Hep. and Musc. Westmorland in Naturalist p. 347 (1898); Pears., Hep. Brit. Isles p. 502 (1902).



1. Fertile thallus. 2. Stoma. 3. Cells. 4. Male receptacle with part of roof removed to show antheridia.

Monoicous. In pale green patches, dark green to blackish when dry. Thallus 5–10 mm in diam., *entirely prostrate* or with the extreme margins slightly ascending, irregularly lobed, the lobes obcuneate, usually divided at the apex *into small linear-quadrate segments*, not costate, the dorsal surface more or less warty, lamellae few or absent; transverse section 8–12 cells high in the middle, the lacunae large and numerous. Involucres frequently geminate, 2·5–4·5 mm long × ·5–·6 mm broad, cylindrical, slightly narrowed at the nearly truncate apex. Capsule 12–20 mm long × ·2–·25 mm broad, dark brown; stomata 60 × 35 μ. Spores 42–48 μ, black, with numerous spines; pseudo-elaters 45–100 μ, 1–3-celled, geniculate. Antheridia *12–20 in groups in large conspicuous receptacles* scattered over the dorsal surface of the thallus.

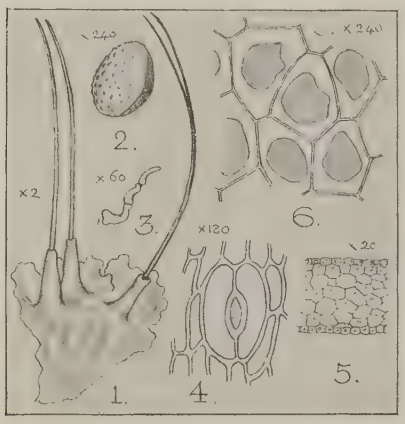
Hab. Moist sandy fields and crumbling sandstone rocks.

Distrib. High Foulshaw, Westmorland, 1879 (*G. Stabler*); Nutley, Sussex (*W. E. Nicholson*). Fr. Sept.–Nov.

The thallus is more prostrate than in *A. punctatus* in the plant from the original locality, and the margin is usually cut into small broadly linear segments. The Sussex plant is not so distinctly prostrate. The only character which appears to be constantly distinctive from *A. punctatus* is the numerous antheridia in each receptacle.

272. Anthoceros laevis L.

Anthoceros laevis L., Sp. Pl. p. 1139 (1753); Nees, Eur. Leb. IV p. 329 (1838).



1. Fertile plant. 2. Spore. 3. Pseudo-elater. 4. Stoma. 5. Section of thallus. 6. Cells.

Monoicous. In *dark green* patches. Thallus 5–15 mm in diam., *nearly flat, smooth*, divided into broad *obovate lobes*, rounded at the apex with the margins entire or crenate, not costate; transverse section 6–8 cells high in the middle *without lacunae;* surface cells 35–70 μ × 30–35 μ. Involucres sometimes geminate, 2–3·5 mm long and ·7–1 mm broad, cylindrical, slightly narrower towards the apex, the mouth repand. Capsule 15–25 mm long and ·35–·5 mm broad, brown; stomata 70–77 × 25–30 μ. Spores 46–56 μ greenish-*yellow*, *thickly granular-papillate*. Pseudo-elaters pale brown, of 1–4 cells, each of 25–45 μ in length, geniculate. Antheridia in groups of 2–3 in receptacles scattered on the dorsal surface of the thallus.

Hab. Moist soil in fields and side of ditches.

Distrib. N. to Caithness, uncommon; Ireland. Fr. Sept.-Dec.

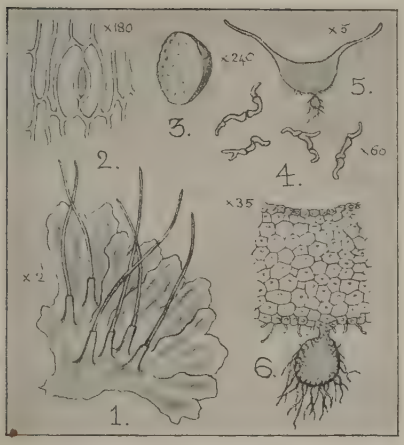
The yellow and not echinate spores will distinguish this from our other species except *A. dichotomus*. When sterile the smooth, flat thallus will generally distinguish it in the field, and if not, a transverse section will show the absence of lacunae. Tubers are occasionally seen in this species, also sometimes granulate thickenings on the margin of the thallus. Nicholson in *Hast. and East Suss. Nat.* p. 290, 1911, mentions a plant which is probably a form of this species; the thallus has crisped edges, portions of which become detached and form new plants.

273. Anthoceros dichotomus Raddi

Anthoceros dichotomus Raddi, Att. Accad. Sien. 9 p. 289 *pl.* 4 (1808).

Anthoceros polymorphus γ *dichotomus* Raddi, Opus. sci. di Bologna 2 p. 359 (1818).

Anthoceros dichotomus Nees, Eur. Leb. IV p. 345 (1838).



1. Fertile thallus. 2. Stoma. 3. Spore. 4. Pseudo-elaters. 5. Section of thallus. 6. Portion of do. more magnified.

Monoicous. In green patches, dark green to blackish when dry. Thallus 5–12 mm long, *prostrate*, with short, usually irregularly divided segments in the fertile plant; *segments in the sterile plant dichotomous, broadly linear or oblong, channelled*, with the margins ascending and sinuate, *carinate postically and with descending tubers at intervals* proceeding from the costa, almost without rhizoids, which however are developed on the tubers; the costa $\frac{1}{8}$–$\frac{1}{3}$ the width of the segments, in transverse section 6–10 cells high, the lamina 1–3 cells high. Involucres single, 2–3·5 mm long × ·5–·8 mm broad, cylindrical, the mouth not contracted, 2-lobed. Capsule 15–25, seldom to 35, mm long × ·2–·25 mm broad, frequently curved, yellowish-brown; stomata 56–65 × 27–35 μ. Spores 32–42 μ, *yellowish*, lightly granular-papillate; pseudo-elaters 56–140 μ, 1–4 cells long, pale brown.

Hab. Moist banks on sea-cliffs.

Distrib. Near Dawlish, Devonshire, 1903 (*C. Blakiston, Mrs. Tindall*).

This rare southern species agrees with *A. laevis* in the colour of the spores, but the channelled, dichotomous, costate segments are quite different from that plant, as they also are from our other species. The costa with its strong convexity beneath is readily seen in a transverse section. The tubers on the English specimens are small but usually evident.

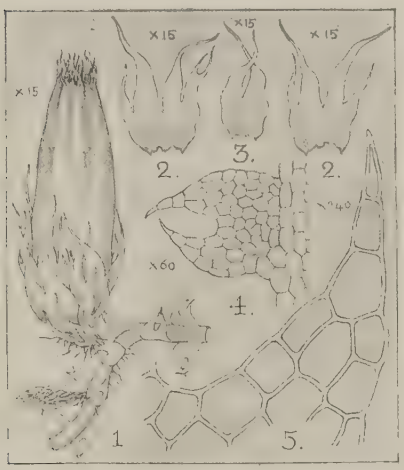
ADDENDA

P. 55. The distribution of *Aneura major* should now read "N. to Fife."

P. 261. Add the following :—

157*. Cephalozia Loitlesbergeri Schiffn.

Cephalozia Loitlesbergeri Schiffn., Oest. bot. Zeit. p. 2 (January 1912); K. Müll., Rabh. Krypt. Fl. II p. 45 (March 1912).



1. Fertile plant. 2. Bracts. 3. Bracteole. 4. Leaf. 5. Cells.

Monoicous. Resembling *C. macrostachya* or *C. media*; leaves antically decurrent, scarcely divided to the middle, with a rotundate sinus, laciniae very acute, connivent (often cruciate at the apex) ending very frequently in a point composed of three superimposed cells. Cells but little larger than in *C. macrostachya*, much smaller than in *C. connivens*. Underleaves none. ♀ branch short, postical. Involucral bracts deeply (beyond $\frac{3}{4}$ or to $\frac{3}{4}$) divided into 4–5 lanceolate lobes ending in a long ciliiform point composed of 3–4 elongated cells, with some additional cilia frequently present. Bracteole 2–3 partite, the lobes as in the bracts. Perianth as in the other members of the genus, the extreme base (to the height of 1–3 cells) 2–3 stratose, otherwise unistratose, the mouth divided into 10–12 laciniae denticulate at the margin, ending in a very long curved cilium (of 4–5 very elongate superimposed cells). Calyptra

pyriform, pluristratose at the base, on the neck of which the sterile archegonia are seated. ♂ branches postical, often near the ♀; bracts concave at the base, frequently supplied with an additional rotundate lobe at the base of the antical margin, otherwise similar to the sterile leaves (Schiffner, loc. cit.).

HAB. In Sphagnum bogs.

DISTRIB. Cockerham Moss, Lancashire, 1900 *(J. A. Wheldon* and *A. Wilson)*. ?

There is a slight doubt if the Lancashire plant is this species. I sent specimens to Schiffner as *C. Loitlesbergeri*?, to which he replied that there was a great probability it was that plant, but it was not quite certain, as fully developed bracts and perianths were not present, and on this account, the question arose whether it might not be *C. compacta* Warnst. It is at least an undescribed British species. I have given a translation of Schiffner's description of *C. Loitlesbergeri*, and Mr. Jameson has drawn the figures from an original specimen which Herr Schiffner kindly sent to me. I have also seen a piece of the original specimen of *C. compacta*; the Lancashire plant appears to me to be much more like *C. Loitlesbergeri* in its long, acuminate leaf-lobes.

In the notes to his description, Schiffner mentions that *C. Loitlesbergeri* agrees with the likewise monoicous *C. compacta* in size, habit and dimensions of leaf-cells, but that *C. compacta* differs, among other points, by the leaves being without, or with less, connivent lobes, the lobes being also much shorter, the involucral bracts quite different, being normally divided into two broadly lanceolate lobes, all the lobes being sharply dentate, the apex having only two scarcely lengthened cells, and the margins with more or less numerous sharply pointed teeth. *C. macrostachya* and *C. media* are dioicous; the former has very long androecia, and the latter has quite different bracts and the mouth of the perianth shortly dentate, as well as less longly pointed leaf-lobes. *C. connivens* has much larger leaf-cells.

P. 253, line 16 from bottom, for "*macrathelia*" read "*macranthelia*," and for "Stocton" read "Stockton."

P. 365, line 12 from bottom. Read "It can be known from all our other species which have any resemblance to it by the stellate leaf-cells," etc.

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